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ABSTRACT

This curriculum guide for students in grades K-4 is part of the My Health My World series which explores environmental health issues. It includes (1) an activities guide for teachers, which focuses on physical science, life science, and environment and health, presenting activity based lessons that entice students to discover concepts in science, mathematics, and health through hands-on activities; (2) a colorful illustrated storybook entitled, "Mr. Slaptail's Curious Contraption," which teaches science and health concepts; (3) a reading activities booklet entitled, "The Reading Link," which presents reading activities to use with "Mr. Slaptail's Curious Contraption"; and (4) "Explorations for Children and Adults," a mini-magazine full of information, activities, and fun things to do in class or at home related to the atmosphere and health; climate; tips for healthy living; and sun power. (SM)

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My Home Planet Earth: My Health My World.

Barbara Tharp
Judith Dresden
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Nancy Moreno

Illustrated by T. Lewis

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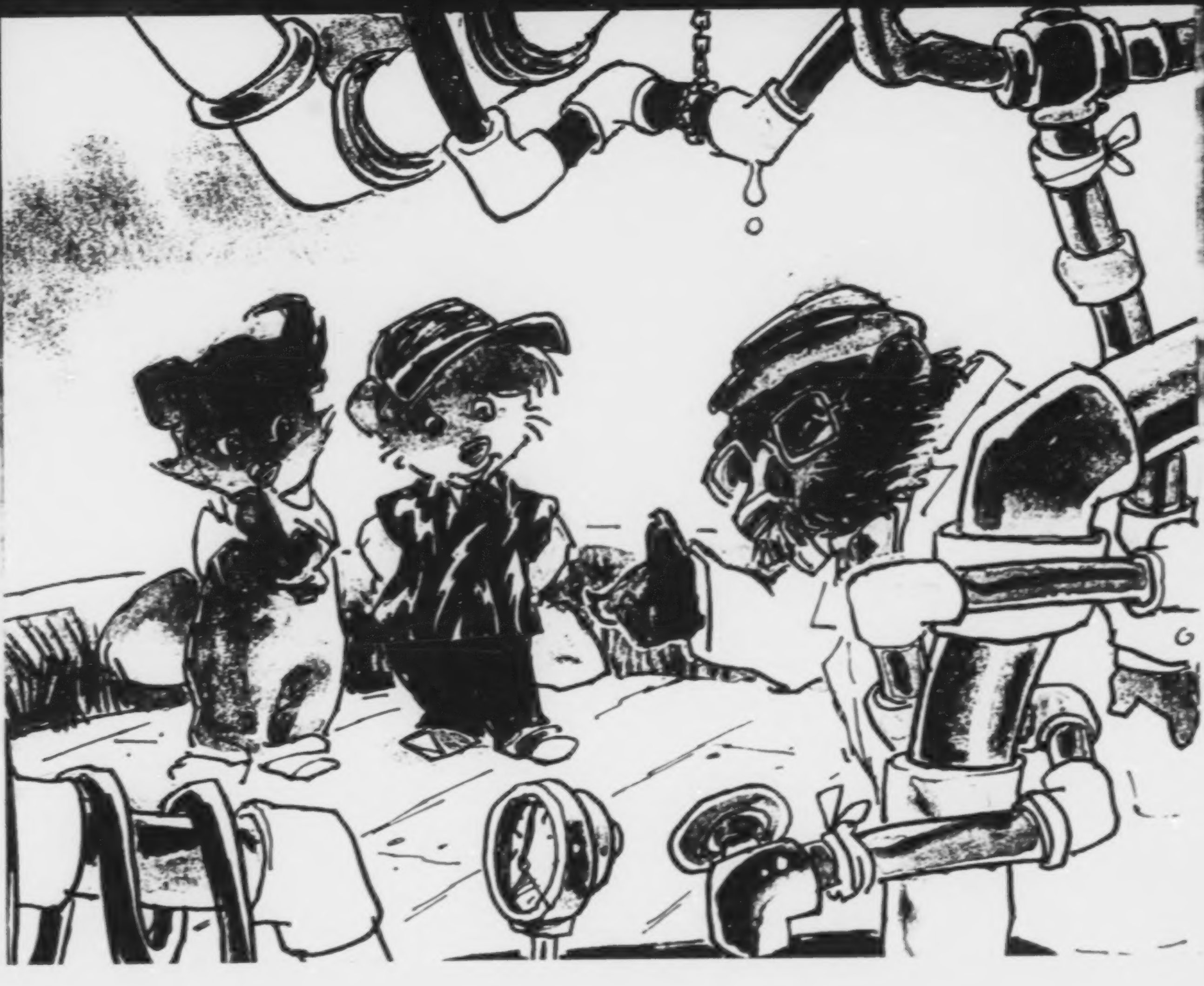
MY HEALTH MY WORLD
MY HOME PLANET EARTH

ACTIVITIES

GUIDE FOR TEACHERS



SP039605

My Health My World®

ACTIVITIES

GUIDE FOR TEACHERS

My Home Planet Earth

Nancy Moreno, Ph.D.
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Baylor College of Medicine

Houston, TX

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The activities described in this book are intended for school-age children under direct supervision of adults. The authors, Baylor College of Medicine and the publisher cannot be responsible for any accidents or injuries that may result from conduct of the activities, from not specifically following directions, or from ignoring cautions contained in the text.

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Table of Contents

Acknowledgments ii
About My Health My World iii
Where Do I Begin? iv
Sample Sequence of Activities, Adventures and Explorations v
Materials and Supplies vi

Physical Science

Physical Science Basics—Energy and the Atmosphere 1
1. Rainbow in the Room 2
What is visible light made of?
2. The Air Up There 4
What are the characteristics of Earth's atmosphere?
3. GeoMuffin 8
Where are fossil fuels and how do we find them?

Life Science

Life Science Basics—Solar Energy and Living Things 15
4. Burning Curiosity 16
What happens when something burns?
5. Feeding Frenzy 20
What happens when living things eat food?
6. SkinWise 22
How much skin does a person have and why is it important?

Environment and Health

Environmental Health Basics—People and Global Change 28
7. Enlightening 29
How can we detect and use energy from the sun?
8. Solar S'Mores 33
Do different substances absorb and trap heat differently?
9. People and Climate 36
How does climate affect how we live?
10. Everyone Counts (Assessment Activity) 40
How is the atmosphere important for human health?

Science and Health for Kids!

These My Health My World Activities are designed to be used with other components of the My Home Planet Earth unit:

My Health My World Adventures
Mr. Slaptail's Curious Contraption

My Health My World Explorations
My Home Planet Earth

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About My Health My World

The My Health My World Project's exciting *Activities, Explorations* and *Adventures* link students, teachers and parents to significant knowledge of the environment and its relationship to human health. Prepared by teams of educators, scientists and health specialists, each My Health My World unit focuses on a different aspect of the environment. The activity-based, discovery-oriented approach of the My Health My World materials is aligned with the *National Science Education Standards* and the *National Health Education Standards.*

The three components of each My Health My World unit help students understand important health and environmental issues.

- *My Health My World Adventures* presents the escapades of Riff and Rosie in an illustrated storybook that also teaches science and health concepts.

MR. SLAPTAIL'S
CURIOUS
CONTRAPTION

- *My Health My World Explorations for Children and Adults* is a colorful mini-magazine full of information, activities and fun things to do in class or at home.

EXPLORATIONS
FOR CHILDREN AND ADULTS

- *My Health My World Activities—Guide for Teachers* presents activity-based lessons that entice students to discover concepts in science, mathematics and health through hands-on activities.

ACTIVITIES
GUIDE FOR TEACHERS

My Health My World materials offer flexibility and versatility, and are adaptable to a variety of teaching and learning styles.

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Where Do I Begin?

The *Adventures, Explorations* and *Activities* components of each My Health My World unit are designed to be used together to introduce and reinforce important concepts for students. To begin a My Health My World unit, some teachers prefer to generate students' interest by reading part or all of the *Adventures* story. Others use the cover of the *Explorations* mini-magazine as a way to create student enthusiasm and introduce the unit. Still others begin with the first discovery lesson in the *My Health My World Activities—Guide for Teachers.*

If this is your first My Health My World unit, you may want to use the pacing chart on the following page as a guide to integrating the three components of the unit into your schedule. When using My Health My World materials for 45 to 60 minutes daily, most teachers will complete an entire My Health My World unit with their students in two to three weeks. If you use My Health My World materials every other day or once per week, one unit will take from three to nine weeks to teach, depending on the amount of time you spend on each session.

The *My Health My World Activities—Guide for Teachers* provides background information for you, the teacher, at the beginning of each activity. In addition, a listing of required materials, estimates of time needed to conduct activities, and links to other components of the unit are given as aids for planning. Questioning strategies, follow-up activities and appropriate treatments for student-generated data also are provided. Student pages are provided in English and in Spanish. The final activity in each *My Health My World Activities—Guide for Teachers* is appropriate for assessing student mastery of concepts.

Using Cooperative Groups in the Classroom

Cooperative learning is a systematic way for students to work together in groups of two to four. It provides an organized setting for group interaction and enables students to share ideas and to learn from one another. Through such interactions, students are more likely to take responsibility for their own learning. The use of cooperative groups provides necessary support for reluctant learners, models community settings where cooperation is necessary, and enables the teacher to conduct hands-on investigations with fewer materials.

Organization is essential for cooperative learning to occur in a hands-on science classroom. There are materials to be managed, processes to be performed, results to be recorded and clean-up procedures to be followed. When students are "doing" science, each student must have a specific role, or chaos may follow.

The Teaming Up model* provides an efficient system. Four "jobs" are delineated: Principal Investigator, Materials Manager, Reporter and Maintenance Director. Each job entails specific responsibilities. Students wear job badges that describe their duties. Tasks are rotated within each group for different activities, so that each student has an opportunity to experience all roles. Teachers even may want to make class charts to coordinate job assignments within groups.

Once a cooperative model for learning has been established in the classroom, students are able to conduct science activities in an organized and effective manner. All students are aware of their responsibilities and are able to contribute to successful group efforts.

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* Jones, R.M. 1990. Teaming Up! LaPorte, Texas: ITGROUP.

Sample Sequence of Activities, Adventures and Explorations

The components of this My Health My World unit can be used together in many ways. If you have never used these materials before, the following outline may help you to coordinate the activities described in this book with the unit's *Adventures* story (*Mr. Slaptail's Curious Contraption*) and *Explorations* mini-magazine (*My Home Planet Earth*).

Similar information also is provided for you in the "Links" section of each activity in this book.

Activity	Concepts	Class Periods to Complete Activity	Links to Other Components of Unit	
			Adventures: *Mr. Slaptail's Curious Contraption*	**Explorations:** *My Home Planet Earth*
1. Rainbow in the Room	Light consists of many wavelengths.	1	Read pages 1–5.	
2. The Air Up There	The atmosphere is a layer of gases surrounding the Earth.	1–2	Read pages 6–9.	*Swirled World* on page 4.
3. GeoMuffin	Fossil fuels are found in layers of soil and rock.	1	Read pages 10–12, science box on page 14.	*Let's Talk About the Atmosphere and Health* on pages 2–3.
4. Burning Curiosity	Plant-based fuels give off carbon when burned.	2	Read pages 12–15.	*Let's Talk About the Atmosphere and Health* on pages 2–3.
5. Feeding Frenzy	Organisms give off carbon when using food.	1	Read pages 16–20.	*Riff and Rosie Talk to Lief Sigren* on page 7.
6. SkinWise	Skin is vital and must be protected.	2	Read pages 21–22, science box on page 20.	*What Is It?* on page 6; *SkinWise* on page 8.
7. Enlightening	Heat from the sun can be harnessed.	1	Read pages 22–24, science box on page 20.	*Sunpower* on page 4; *We Can Make a Difference!* on page 5.
8. Solar S'Mores	Different materials absorb and trap heat differently.	1	Read pages 24–27, 30–31.	*Not Such a New Issue* on page 6; *Riff and Rosie Talk to Lief Sigren* on page 7.
9. People and Climate	Climate affects all aspects of human life.	2 or more	Science boxes on pages 27–29.	Cover Activity; *What Is Climate* on page 2.
10. Everyone Counts	Assessment activity	1 or 2	Review science boxes throughout.	*Tips for Healthy Living* on page 3.

Using This Unit with Students at the K–1 Level

Some modifications for younger students are appropriate. To begin the unit, introduce students to the main characters in the My Health My World Adventures storybook. Then read the beginning of the story to the students. Follow this by demonstrating the paper-folding activity in the back of the storybook. Next, have the students do the paper-folding themselves, with a few helping hands, or make the folded items for the entire group ahead of time.

Each story session should cover only about five pages of the book, accompanied by science concepts. The mini-magazine should be incorporated as appropriate. Many of the hands-on activities in this guide are more appropriately conducted for younger children as teacher demonstrations, unless you have several helpers to assist with the activities.

Materials

You will need the following materials and consumable supplies to teach this unit with 24 students working in six cooperative groups.

Equipment and Materials

Bracketed numbers correspond to the activities in which the item is used.

6	graduated cylinders or measuring cups [7]
6	tape measures [6]
6	unbreakable or metal-backed thermometers [7]
	clear glass or beaker, quart-size [1]
	large beaker or "Pyrex" bowl [4]
	colored markers or crayons [1, 2, 3, 6, 10]
	flashlight [9]
	overhead projector [1]
	pencils or pens [10]
	scissors [2]
	tempered glass bowl or cup, or beaker [4]

Consumable Supplies

Bracketed numbers correspond to the activities in which the item is used.

24	aluminum baking cups and a cookie sheet or paper liners and muffin tins to bake [3]
24	chocolate candies ("kisses" or squares, not coated) [8]
24	clear plastic cups [7, 8]
24	cotton swabs [3]
24	muffins [3; see baking instructions on page 14]
24	plain, round cookies [8]
24	plastic straws [3]
12	clear plastic cups [5]
12	stirrers or spoons [5]
7	short, wide candles [4]
7	heavy-duty zip-style sandwich bags [5]
6	oranges [6]
6	large sheets of paper or poster boards [9]
6	plastic knives [3, 6, 8]
6	sheets black construction paper [8]
6	sheets white construction paper [8]
6	teaspoons dry yeast [5]
2	envelopes of Bran Muffin mix (plus ingredients listed on package) [3; for muffins, page 14]
2	envelopes of Corn Muffin mix (plus ingredients listed on package) [3; for muffins, page 14]
	3 m sheet of brown or white paper approximate 1 m in width [2]
	aluminum foil [4, 8]
	teaspoon baking soda [5]
	balloon [9]
	construction paper in several colors [2, 9]
	container marshmallow cream or white frosting [8]
	glue or paste [9]
	matches [4]
	sheet of paper or notebook [6]
	paper towels [4, 6]
	purple cabbage, 1 head, sliced [5]
	red and green food coloring [3; for muffins, page 14]
	sugar (about 1 cup) [4, 5]
	tape or glue [2, 6, 9]
	tape or stapler [8]
	large tray or paper plate [8]
	vinegar [5]
	warm water [5]
	wax paper [6]
	white paper for drawing [1, 10]

Physical Science Basics

Energy and the Atmosphere

Energy from the Sun

The sun is the source of the Earth's energy. Every second, approximately five million tons of matter within this relatively small star are converted into energy, which is sent outward into space. We can feel part of this energy as heat and see another part of it as light. Heat and light that we can detect, however, represent only a small part of the radiation that is emitted by the sun.

Radiation travels in waves, similar in some ways to the waves on the surface of a lake. The distance measured between the peaks or crests of two successive waves is known as the wavelength. The longest wavelengths correspond to television and radio signals, which fall between 1 and 1,000 meters. The shortest wavelengths, those of cosmic rays, are only 0.000,000,000,000,01 meters long!

The Atmosphere

Radiation traveling toward Earth passes through a thin layer of gases called the atmosphere. Without this layer, which is protective in several ways, life on Earth would be impossible. The Earth's atmosphere consists primarily of nitrogen and oxygen. Other gases include argon, carbon dioxide and water vapor. The atmosphere keeps the planet warmer than it would otherwise be; provides oxygen, moisture and carbon dioxide; and prevents most harmful ultraviolet radiation from reaching the surface.

Energy We Can Use

Green plants and algae (related plant-like organisms that usually grow in water) are able to absorb energy from the sun and use it to combine carbon dioxide (CO_2) from the atmosphere with water to make energy-rich molecules, such as sugars and carbohydrates. Green plants and their products form the base of almost all food webs on Earth. They also are the sources of the most common fuels that we use.

Fuels such as wood, coal, oil and natural gas all are composed of matter originally produced by plants. Each of these holds energy, originally trapped during photosynthesis, in the chemical bonds of carbon-containing molecules. When these substances are burned, heat energy is released that can be used for many purposes.

Our uses of fossil fuels have grown dramatically since the 1800s. During the Industrial Revolution, coal was used to power steam engines in mines, factories, locomotives and ships. Later, it was used to generate electrical power. The discovery of large deposits of petroleum led to widespread applications in fuels for transportation, heating and production of electricity. When fossil fuels are burned, carbon-containing molecules combine rapidly with oxygen. This chemical reaction releases energy in the form of heat. It also releases CO_2 again into the air. Many other chemical substances that are produced by the burning or incomplete burning of fossil fuels.

The Spectrum

Radiation travels in waves. The wavelengths that we see as visible light represent a small portion of the entire electromagnetic spectrum.

Light usually is measured in nanometers (one nanometer = 0.000,000,001 meters). Wavelengths that we can see fall between 400 and 700 nm. Green plants capture energy of about the same wavelengths during photosynthesis.

Some kinds of radiation are listed below, from longest to shortest wavelengths.

- Long wave radio
- Short wave radio
- Radar
- Microwaves
- Visible light
- Ultraviolet light
- X-rays
- Gamma rays
- Cosmic rays

All radiation, including light, travels at the same speed— about 300,000,000 meters per second.

The so-called fossil fuels— coal, oil and natural gas— consist of buried partially-rotted tissues of ancient plants and animals that have undergone intense pressures and high temperatures for millions of years. The resulting substances are able to deliver much more useful energy than raw plant materials such as wood.

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1. Rainbow in the Room

Background

Light that we can see is just part of the entire spectrum of radiation that is produced by the sun. The sun bombards the Earth with radiation of many different wavelengths at the same time. Most of the radiation emitted by the sun can be classified as infrared (which we feel as heat) or visible (which we see as light and color). However, the sun also produces higher energy radiation, such as ultraviolet (or UV) radiation, x-rays, and gamma rays.

Electromagnetic radiation, including light, behaves as if it travels in waves. The distance between wave crests (wavelength) and the speed with which they pass a fixed point (frequency) are related to the amount of energy contained in the bundles of energy or photons that make up the wave. Radiation of shorter wavelengths (which travel at higher frequencies) has more energy than radiation of longer wavelengths. Visible light falls between the longer wavelengths of infrared radiation and shorter, higher energy wavelengths of ultraviolet radiation.

Visible light consists of a mix of wavelengths that we detect as different colors. We can see these colors when white light passes through a prism—or drops of water—and forms a rainbow.

The colors of the rainbow always appear in the same order, because they correspond to different wavelengths of light. You may have learned the acronym, "ROY G. BIV," to help you remember the colors of the rainbow from longest to shortest wavelengths: red, orange, yellow, green, blue, indigo, and violet.

Links

This activity may be taught along with the following component of the My Home Planet Earth unit.

Adventures:
Mr. Slaptail's Curious Contraption, pages 1–5

Set-up

This activity requires no prior preparation. However, for dramatic effect, you may want to set it up while students are out of the classroom for lunch or another activity.

Have students work in groups to share materials as they create their own rainbow designs.

Procedure

1. Fill a clear, liter-sized glass or plastic container with water and place it on the lighted "stage" of an overhead projector.
2. Darken the classroom as much as possible. You and your students will be able to observe a circular rainbow projected around the classroom.
3. Allow a few moments for students to observe the rainbow. Ask, *Have you ever seen anything like this before?* Students will

CONCEPTS

- Visible light is composed of many different wavelengths of radiation.
- We can see different wavelengths of light as the colors of the spectrum.

OVERVIEW

This activity generates student excitement about light through the creation of a room-sized rainbow.

SCIENCE & MATH

- Observing
- Identifying patterns
- Drawing conclusions

TIME

Preparation: no advance preparation necessary
Class: 20 minutes

MATERIALS

- large liter-sized clear beaker or quart-sized glass jar or other similar clear container
- overhead projector
- white paper (one sheet per student)
- colored markers or crayons

Rainbows

A rainbow is formed when white light passes at an angle from one transparent material (such as air) into another (such as water or glass). The waves corresponding to different colors of light travel at slightly different speeds, so they are dispersed differently by the second material.

provide a variety of responses. Follow by asking, *Do you think the colors are the same in every rainbow?* After students have shared their ideas, mention that every rainbow does have the same sequence of colors. Explain that the colors of light represent energy of different wavelengths.

4. Have students identify the source of light for the rainbow (white light from the overhead projector). Then, help them understand that the light has been separated into its constituent colors as it passes through the water in the container.
5. Let each student make his or her own "Rainbow" drawing by incorporating the sequence of colors that they observe in the classroom rainbow into a drawing of their own choice. Display the Rainbow drawings.

Variations

• Conduct further explorations of the spectrum by using prisms outside with sunlight and/or indoors with light from incandescent or fluorescent bulbs.

• Demonstrate to students that all rainbows show the same sequence of colors, by placing several small clear glass or plastic containers of water on the overhead projector at the same time. Have students compare the rainbows that are produced.

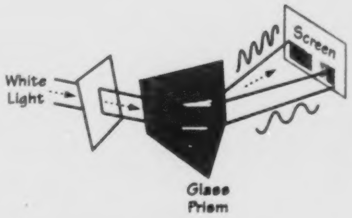
• Help students understand waves by modeling wave motion with a spring toy ("slinky"). Lay the spring on a table top and wave one end from side to side. Students will be able to see waves move along the length of the spring.

• Explore the vast differences among wavelengths in the electromagnetic spectrum by measuring out the lengths of some of the following kinds of waves and displaying them in the classroom and/or by measuring them on the playground:

100 m	AM radio waves
10 m	FM radio waves
1 m	television waves
1 cm	microwaves, such as those used to cook food
less than 1 mm	infrared waves, felt as heat

• Printers use combinations of three colors (cyan, magenta and yellow) with black to create all of the colors in a printed document. Have students examine color photographs, comics or advertisements printed in the newspaper using a magnifier. Have them identify the combinations of colored dots used to create colors such as orange, green and purple.

Prisms



More than 300 years ago, Sir Isaac Newton, a famous physicist, demonstrated how a prism splits white light into a continuous spectrum.

2. The Air Up There

Background

The air surrounding the Earth is known as the atmosphere. The gas molecules in the atmosphere are held relatively close to the Earth's surface by gravity. The atmosphere is mostly nitrogen (78%) and oxygen (20%). The amount of water vapor in the atmosphere varies, but can be as much as 5% by volume. Other gases, present in much smaller amounts, also are extremely important parts of the atmosphere. Carbon dioxide (CO_2), methane (CH_4) and other gases, including water vapor, help radiate heat back toward the Earth's surface, thus keeping it much warmer than it would be otherwise. Ozone, which is present in tiny amounts in part of the atmosphere, filters out most of the harmful ultraviolet radiation from the sun.

Life on Earth would not be possible without the atmosphere, which protects the surface from extremes of temperature and harmful radiation, and also provides essential water, carbon dioxide, oxygen and nitrogen. This activity helps students learn about Earth's atmosphere by creating a scale model.

Links

This activity may be taught along with the following components of the My Home Planet Earth unit.

Adventures:
Mr. Slaptail's Curious Contraption, pages 6–9
Explorations:
Swirled World, page 2

Set-up

Divide students into six groups (approximately four students per group). Each group will be responsible for creating a different part of the model, which should be assembled and displayed on the floor or on the wall. Copy and cut out the job cards on page 6 before beginning.

Procedure

1. Ask students if they ever have seen pictures of the suits that astronauts wear in space. Ask, *Why do the astronauts wear special suits?* Mention that the space suits keep the astronauts warm, provide them with air to breathe and protect them from harmful rays from the sun. Follow by asking if we need to wear space suits here on Earth. Help students recognize that the thin layer of gases surrounding the Earth—the atmosphere—provides protection for all of the planet, just as the space suits protect the astronauts.
2. Mention that, as a class, the students will create a scale model of the Earth's protective layer of gases. Lay a sheet of brown or white paper (at least 2.5 m long) on the floor where students can work on it. Discuss the scale of the model with students: 2 cm = 1 km.

CONCEPTS

- The atmosphere consists of layers of gases surrounding the Earth.
- The layers have different characteristics.

OVERVIEW

By creating a scale model of the atmosphere, students learn about its composition and structure.

SCIENCE & MATH SKILLS

- Measuring
- Modeling
- Inferring

TIME

Preparation: 10 minutes
Class: one or two sessions of approximately 30 minutes

MATERIALS

- 3 m sheet of brown or white paper (approximately 1 meter in width)—wrapping or banner paper sold in rolls works well

Each group of students will need:

- construction paper in several colors
- scissors
- crayons or markers
- tape or glue
- Job Cards from Atmosphere Model page

3. Divide the students into six groups and give a job card to each group. Each group will create and decorate a different part of the atmosphere model as follows. Older students should measure and draw their own lines on the model. You probably will want to mark the lines ahead of time for younger students.

   Group 1—Planet Earth: draws a vertical line about 15 cm from the left margin or bottom of the mounted sheet of paper (this line represents the Earth's surface); creates structures typical of surface (mountains, forests, cities, etc.), using construction paper or other materials and adds them to the model. Remind students that the figures they create should be no more than 5 cm tall.

   Group 2—First Layer of the Atmosphere (Troposphere): draws a line about 22 cm from the line for the Earth's surface (this line represents the upper limit of the first layer); adds figures of weather phenomena (clouds, rain, lightening, wind, etc.), as well as low-flying aircraft and hot air balloons. Point out to students that much of the pollution produced by burning wood and fossil fuels stays within the troposphere. In addition, the gases responsible for keeping the Earth warm (greenhouse gases) are found in this layer. Temperatures within the troposphere decrease with altitude.

   Group 3—Second Layer of the Atmosphere (Stratosphere): draws a line about 100 cm from the line for the Earth's surface (this line represents the upper limit of the second layer); adds figures of storm clouds, jet aircraft, wind, and a representation of the protection provided by ozone molecules in this layer. The stratosphere is warmer due to absorption of UV light by ozone.

   Group 4—Third Layer of the Atmosphere (Mesosphere): draws a line about 160 cm from the line for the Earth's surface (this line represents the upper limit of the third layer); adds figures of feathery ice clouds and weather balloons. The temperatures in the mesosphere are very cold.

   Group 5—Fourth Layer of the Atmosphere (Thermosphere): adds figures of spacecraft, satellites and meteors to the model. The thermosphere continues for many thousands of kilometers beyond the mesosphere, so this group may use the remainder of the space on the sheet. This layer is very hot, sometimes up to 2000°C or more, due to absorption of radiation by different atoms and molecules.

   Group 6—Space Outside the Earth: creates figures representing other components of the solar system and universe, and places them around the room.

4. Have each group label its layer on the model. Display the model somewhere in the classroom. Encourage students to note that most of the activities involving the atmosphere are located very close to the Earth's surface. Leave the model available for students to refer to throughout the unit.

Scale Model

In the atmosphere model created by students, 2 cm represent 1 km. Based on these proportions, the diameter of the Earth would have to be drawn as approximately 25,000 cm. The sun would be positioned 300,000,000 cm away!

Good and Bad Ozone

Ozone, a highly reactive gas molecule made of three oxygen atoms, is found naturally in the stratosphere. Even though it is present only in tiny amounts, ozone in this layer is vital to the planet. It absorbs most of the harmful ultraviolet radiation emitted by the sun and prevents it from reaching the surface.

Near the ground, ozone often is produced as a by-product of burning fossil fuels. Unfortunately, in this instance, ozone is very harmful. Ozone can damage lungs and is harmful to other living things, such as plants.

Atmospheric Layers

The approximate distances of the outer limits of each of the layers of the atmosphere are:

Troposphere - to 11 km
Stratosphere - to 50 km
Mesosphere - to 85 km
Thermosphere - to 3,200 km
(approximately)

Word Origins

Atmosphere comes from the Greek word *atmos* (vapor) and the Latin *sphaera* or Greek *sphaira* (ball). The names of the layers of atmosphere combine the same root with tropos-, from the Greek *tropos* (to turn); stratos-, from the Latin *stratum* (layer); meso-, from the Greek *mesos* (middle); and thermo-, from the Greek *therme* (heat).

Atmosphere Model

Job Cards

Group 1
Surface of Planet Earth

1. Draw a line across one of the short sides of the sheet of paper about 15 cm from the edge. This line represents the Earth's surface.

2. Make figures that show different things found on the surface of the Earth (like mountains, oceans, forests and buildings). The figures should be no taller than 5 cm so that they will fit. Glue or tape your figures onto the model.

Group 2
First Layer of the Atmosphere: the Troposphere

1. Draw a line about 22 cm from the line for the Earth's surface. This line represents the upper limit of the first layer.

2. Make figures to represent weather (like clouds, rain, lightening and wind), as well as low-flying aircraft and hot air balloons. Glue or tape your figures onto the model within the Troposphere.

Group 3
Second Layer of the Atmosphere: the Stratosphere

1. Draw a line about 100 cm from the line for the Earth's surface. This line represents the upper limit of the second layer.

2. Make figures of storm clouds, jet aircraft, winds, and the protection provided by ozone in this layer. Glue or tape your figures onto the model within the Stratosphere.

Group 4
Third Layer of the Atmosphere: the Mesosphere

1. Draw a line about 160 cm from the line for the Earth's surface. This line represents the upper limit of the third layer.

2. Make figures of feathery ice clouds and weather balloons. (The temperatures in the Mesosphere are very cold.) Glue or tape your figures onto the model within the Mesophere.

Group 5
Fifth Layer of the Atmosphere: the Thermosphere

1. The thermosphere goes on for thousands of kilometers, so your group can place its figures on the rest of the sheet.

2. Make figures of spacecraft, satellites and meteors. (This layer is very hot.) Glue or tape your figures onto the model.

Group 6
Space Outside the Earth's Atmosphere

1. Make figures representing other parts of the solar system and universe.

2. Place your figures anywhere around the room.

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Modelo de la Atmósfera

Tarjetas de Responsabilidades

Grupo
1
Superficie de la Tierra

1. Dibujen una línea a lo largo de uno de los lados cortos del papel. Esta línea representa la superficie de la Tierra.

2. Hagan figuras de diferentes cosas que se encuentran sobre la Tierra (por ejemplo, montañas, oceanos, bosques y edificios). Las figuras no deben de tener más de 5 cm de alto. Usen pegamento o cinta para colocar las figuras en el modelo.

Grupo
2
Primera Zona de la Atmosphera: La Troposfera

1. Dibujen una línea aproximadamente 22 cm de la línea que representa la superficie. La nueva línea representa el límite superior de la primera zona.

2. Hagan figuras de aviones, globos y que corresponden al tiempo (por ejemplo, nubes, lluvia y rayos). Usen pegamento o cinta para colocar las figuras en el modelo.

Grupo
3
Segunda Zona de la Atmosphera: La Estratosfera

1. Dibujen una línea aproximadamente 100 cm de la línea que representa la superficie. La nueva línea representa el límite superior de la segunda zona.

2. Hagan figuras de cosas como nubes de tormentas, aviones de reacción, viento y la capa de ozono. Usen pegamento o cinta para colocar las figuras en el modelo.

Grupo
4
Tercera Zona de la Atmosphera: La Mesosfera

1. Dibujen una línea aproximadamente 160 cm de la línea que representa la superficie. La nueva línea representa el límite superior de la tercera zona.

2. Hagan figuras de cosas como nubes de hielo y globos meteorológicos. (La Mesofera es muy fría.) Usen pegamento o cinta para colocar las figuras en el modelo.

Grupo
5
Cuarta Zona de la Atmosphera: La Termosfera

1. La Termosfera extiende por miles de kilómetros, entonces su grupo puede usar el resto del papel para sus figuras.

2. Hagan figuras de cosas como naves espaciales, satelites y meteoros. Usen pegamento o cinta para colocar las figuras en el modelo.

Grupo
6
El Espacio Fuera de la Atmosfera

1. Hagan figuras que representan otras partes del sistema solar y del universo.

2. Coloquen sus figuras dondequiera en el salon.

3. GeoMuffin

Background

In the United States, more than 75% of the energy used in homes and businesses, and for transportation comes from coal, oil or natural gas. These fuels are known as "fossil" fuels because they are the remnants of ancient plants and other organisms that were buried under intense heat and pressure over millions of years. The resulting substances are very efficient sources of energy. Of course, one needs to keep in mind that the energy in fossil fuels originally came from the sun and was trapped by plants during photosynthesis. During this process, plants also consumed carbon dioxide (CO_2) from the atmosphere. When fossil fuels are burned, trapped carbon is released back into the atmosphere, principally as CO_2 again.

- **Petroleum** or crude oil is a thick, gooey liquid that can be found within the Earth's crust on land or beneath the sea floor. It was formed from tiny marine organisms that were buried in layers of sediment, such as sand. In addition to containing high-energy carbon compounds, petroleum contains varying amounts of substances with oxygen, sulfur and nitrogen. Crude oil must be heated and distilled to separate it into gasoline, heating oil, diesel oil, asphalt and other materials. Some components of crude oil are used to manufacture industrial chemicals, fertilizers, pesticides, plastics, medicines and other products.
- **Natural gas** is a mixture of methane and smaller amounts of related gases. Natural gas often is found above deposits of crude oil. Natural gas burns hotter and produces less air pollution than any other fossil fuel. When burned, it also releases less carbon dioxide relative to the amount of energy that is produced.
- **Coal** is a solid that is formed in several stages. It is a mixture of many different substances, with varying amounts of water, nitrogen and sulphur. Coal is formed from peat—a moist soil material made of partially decayed plant material. When peat is subjected to intense heat and pressure, it becomes lignite—a brown coal. Lignite will become bituminous coal if it is placed under more heat and pressure. Bituminous coal is used extensively as fuel because it produces high levels of heat and is abundant. The most desirable form of coal is anthracite, a hard mineral that results from the transformation of bituminous coal under conditions of very high heat and pressure. Anthracite is a very attractive fuel because it burns cleanly and produces great quantities of heat.

When geologists look for sources of fossil fuels they often drill deep into the Earth. They remove narrow cores of rock and sediments and examine them for clues about the presence of oil and other fuels. This

CONCEPTS

- Fossil fuels are found within the Earth's crust.
- The presence of certain layers of soil and rock helps predict the presence of oil.
- The supply of fossil fuels cannot be replenished.

OVERVIEW

Students will learn about how geologists locate fossil fuels by using a straw to extract core samples from a model that has different layers.

SCIENCE & MATH SKILLS

- Predicting
- Observing
- Identifying patterns
- Mapping
- Drawing conclusions

TIME

Preparation: 45 minutes (time necessary to create and bake muffins)

Class: 30 – 45 minutes

MATERIALS

To bake 24 GeoMuffins, you will need:

- 24 aluminum baking cups and a cookie sheet or 24 paper liners and sufficient muffin pans
- 2 envelopes of Bran Muffin mix (plus ingredients listed on mix)
- 2 envelopes of Corn Muffin mix (plus ingredients listed on mix)
- red and green food coloring

Each student or pair of students will need:

- GeoMuffin (baked previously; see Set-Up)
- section of plastic straw about 8 cm (3 inches) long
- cotton swab
- plastic knife
- colored markers or crayons
- copy of GeoMuffin Observations page

activity lets students explore the layers in a muffin representing the Earth's crust, using a straw to drill cores.

Links

This activity may be taught along with the following components of the My Home Planet Earth unit.

Adventures:
Mr. Slaptail's Curious Contraption, pages 10–12;
Science Box, page 14

Explorations:
Let's Talk About the Atmosphere and Health, pages 2–3

Set-Up

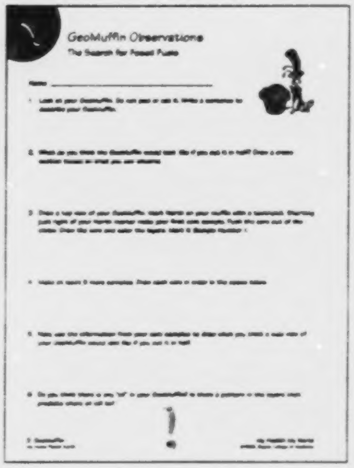
You will need to bake the GeoMuffins in advance, using two envelopes of prepared Bran Muffin mix and two envelopes of Corn Muffin mix (other flavors may be substituted as long as they are different colors; cake mixes usually are less satisfactory because the baked texture is too soft). Follow the instructions on the GeoMuffin Recipe (page 14) to prepare the muffins. You will need enough muffin tins and paper liners for 24 muffins or 24 aluminum baking cups on a cookie sheet.

Procedure

1. Show the muffins to the class. Point out that all of the muffins look the same on the surface. Tell students that the muffins are made of layers that look similar to those visible in a cross section of the Earth's crust. Explain that they will be exploring their muffins to discover whether or not the muffins hold petroleum deposits, and where those deposits might be located. Lead the class in a discussion of how fossil fuels were formed under the ground, how they are mined and how they are used.
2. Give a muffin and a GeoMuffin Observations page to each student or team of students. Ask, *What do you think the inside of the muffin looks like?* Without touching or removing the baking cup, instruct the students to draw their predictions on their Observations pages. They also should predict whether or not they think they will find oil. (The red layer in the muffin represents oil.)
3. Demonstrate the technique to be used. Show the students how to take a core sample by gently twisting a section of plastic drinking straw into a muffin and then pulling it back out. Use a cotton swab to dislodge the core by inserting it in the top of the straw and pushing the core out the bottom.
4. Encourage students to take at least six samples, recording each sample's location on their worksheets, and then drawing and coloring the samples in order.
5. Once they have finished sampling, recording and coloring, students should evaluate their information, looking for a pattern. Based on their cores, students should draw an estimate of a side view of the muffin, showing all the layers.
6. Now, instruct the students to cut through the center of the muffin.

Legacy of Fossil Fuels

Fossil fuels have supported unprecedented economic growth during the last century. Use of these fuels also is responsible for much of the world's air and water pollution, and has increased the levels of heat-trapping gases such as carbon dioxide and methane in the atmosphere.


GeoMuffin Observations
The Search for Fossil Fuels

Each student or team of students will explore a GeoMuffin model that represents layers of soil and rock.

The colored layers in the muffin represent the following:

Red = oil
Green = predicting layer for oil
Yellow = soil or rock layer
Brown = soil or rock layer

They should compare their predictions with their muffins. Ask, *Did the core samples give you valuable information? Why or why not? Did you find anything that predicts the presence of oil?* Mention that geologists frequently look for certain patterns of layers in the cores. Some kinds of patterns predict or suggest that oil might be present.

7. Have students consider petroleum as a resource. Ask, *What happens when we burn products made from oil? Does burning oil produce carbon dioxide? Do you think we could run out of oil?* Help students understand that oil and coal are resources that cannot be replaced once they have been "used up."
8. Initiate a discussion about where oil and other fossil fuels come from. Use the Carbon Cycle page as an overhead to help students understand how photosynthesis by ancient plants is responsible for the carbon now found in fossil fuels. Challenge students to figure out what happens to the carbon in fossil fuels when the fuels are burned (carbon returns to the atmosphere as carbon dioxide).

Variations

- Instead of having students cut their muffins in half after making their predictions, challenge them to restore the landscape on the top of their muffins before proceeding with the rest of the activity.

Questions for Students to Think About

- How many different uses of fossil fuels are there? Use the library or the Internet to look for answers.
- What will happen when we use up the supplies of fossil fuel? Do you think that we can get any more? Why or why not? Are there any good substitutes for some of the uses of fossil fuels?
- How much oil and natural gas are still left on Earth? Look for answers in the library or on the Internet. What might be done to ensure wise use of these resources?

Carbon Cycle

Carbon is the basic building block for many molecules in living organisms. Producers take carbon from carbon dioxide gas (CO_2) and create substances such as glucose (a kind of sugar) through photosynthesis. All other living things rely on producers for food.

When food is broken down or digested, carbon is converted back into CO_2, which is released into the atmosphere.

Other processes, such as burning and decomposition, also release CO_2 back into the atmosphere. In the oceans, some carbon is incorporated into the shells of organisms and becomes deposited in sediments.

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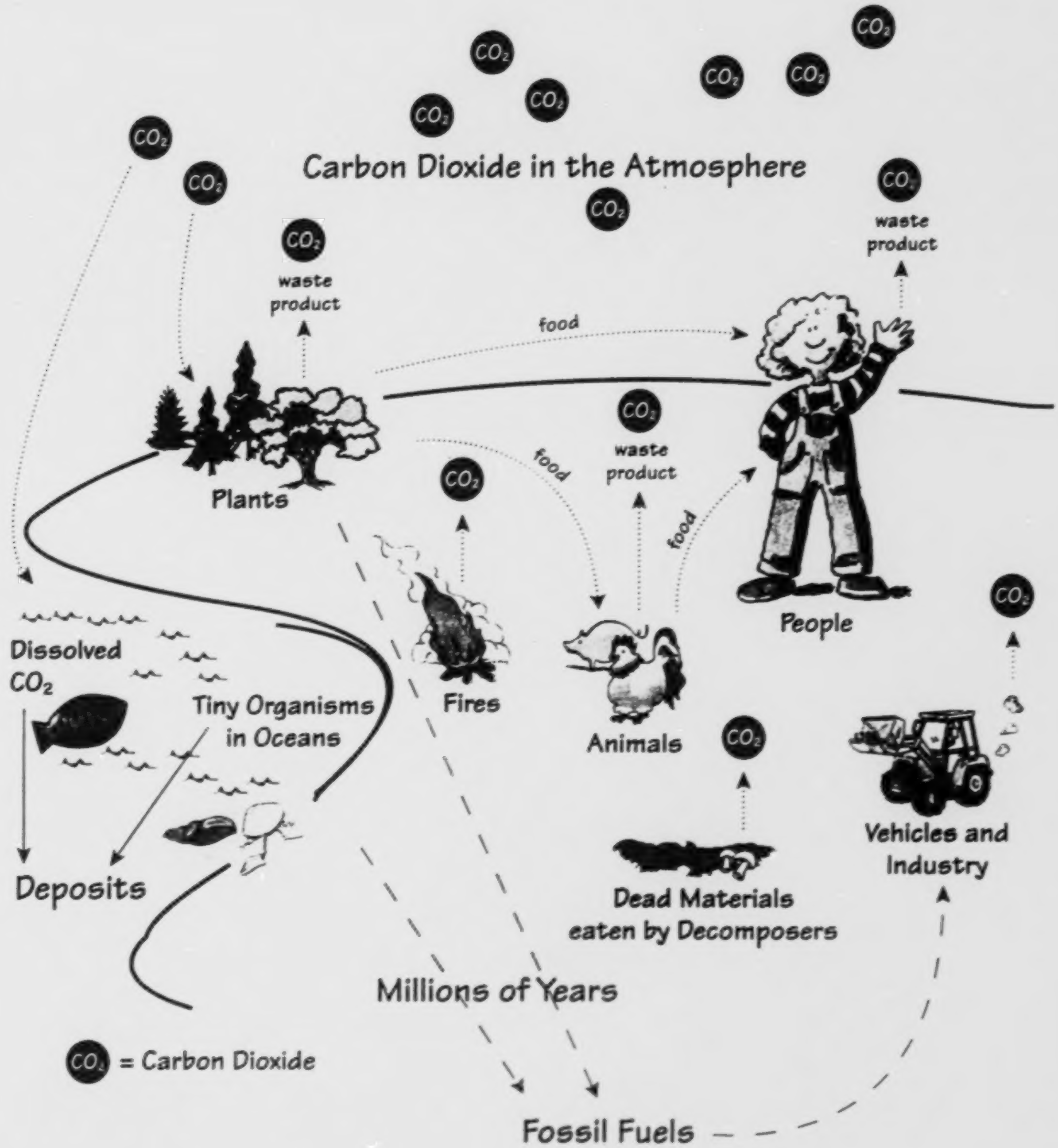
Carbon Dioxide and the Carbon Cycle


Carbon Dioxide in the Atmosphere
CO₂
waste product
food
Plants
Fires
Animals
People
Dissolved CO₂
Tiny Organisms in Oceans
Deposits
Dead Materials eaten by Decomposers
Vehicles and Industry
Millions of Years
Fossil Fuels
CO₂ = Carbon Dioxide

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GeoMuffin Observations

The Search for Fossil Fuels

Name ______________________________

1. Look at your *GeoMuffin*. Do not peel or eat it. Write a sentence to describe your GeoMuffin.

2. What do you think the GeoMuffin would look like if you cut it in half? Draw a cross section based on what you can observe.

3. Draw a top view of your GeoMuffin. Mark North on your muffin with a toothpick. Starting just right of your North marker make your first core sample. Push the core out of the straw. Draw the core and color the layers. Mark it *Sample Number 1*.

4. Make at least 5 more samples. Draw each core in order in the space below.

5. Now, use the information from your core samples to draw what you think a side view of your GeoMuffin would look like if you cut it in half.

6. Do you think there is any "oil" in your *GeoMuffin*? Is there a pattern in the layers that predicts where oil will be?

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Bizcochos Geológicos

La Buzqueda para los Combustibles Fósiles

Nombre ________________________________

1. Examina tu Bizcocho Geológico sin tocarlo o comerlo. Escribe una oración que describe tu bizcocho.

2. Como piensas que se vería si partieras el bizcocho a la mitad? Dibuja una vista de la mitad del bizcocho basado en lo que puedes observar.

3. Dibuja el bizcocho visto desde arriba. Usando un palillo marca el Norte. Empezando a la derecha del marcador del Norte, toma tu primera muestra con un popote. Saca la sección de bizcocho del popote. Dibuja la sección y colorea las capas. Márcala Muestra Número 1.

4. Toma por lo menos 5 muestras más. Dibuja cada muestra en el espacio abajo.

5. Ahora, utiliza la información de tus muestras para dibujar lo que piensas sería una vista de tu bizcocho si lo cortaras a la mitad.

6. ¿Piensas que hay "petroleo" en tu bizcocho? ¿Demuestran las capas algunas características que predicen la presencia de petroleo?

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GeoMuffin Baking Instructions

Materials and Ingredients

- 24 aluminum baking cups and a cookie sheet or 24 paper liners and sufficient muffin pans
- 2 envelopes of Bran Muffin mix (plus ingredients listed on package)
- 2 envelopes of Corn Muffin* mix (plus ingredients listed on package)
- Food coloring (red and green)
- 2 medium-sized mixing bowls
- 2 small mixing bowls

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* Note: Other types of muffin mixes without fruit or nuts may be substituted. Do not use cake mixes.

Baking Instructions

1. Preheat oven to temperature specified on the muffin mixes. If different temperatures are given on the two kinds of mixes, set oven to the lower temperature.
2. Line muffin tins with 24 paper bake cups or set 24 aluminum bake cups on a cookie sheet.
3. Combine both packages of Bran Muffin mix in one medium-sized bowl and prepare batter by following the instructions on the packages. If the mixture is very stiff, add additional milk or water so that the consistency of the batter is slightly runny.
4. Prepare the packages of Corn Muffin mix in the second medium-sized bowl. Remove about 1/4 cup of the batter from the bowl and color it deep red using food coloring (this will represent oil in the GeoMuffin). Color another 1/2 cup of the remaining batter green.
5. Add batter to the muffin cups in the following order:

   teaspoon of bran batter across bottom of each cup
   1/2 teaspoon of green on one side of muffin
   1/2 teaspoon of yellow on other side of muffin (next to green)
   1/4 teaspoon of red spread over green batter only
   1/2 teaspoon of green spread to cover red
   1/2 to 1 teaspoon of yellow over entire muffin
   1/2 to 1 teaspoon of bran over entire muffin

6. Bake according to package instructions.
7. Cool before using with students. Muffins are firmer and easier to sample if they are baked a day in advance.

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Life Science Basics

Solar Energy and Living Things

Carbon in Living Things

Almost all of our energy sources come from materials that have been produced by plants and other organisms capable of using energy from the sun to build molecules necessary for life. The oil, natural gas and coal that have been essential for the development of our modern industrial world all are made up of the remains of dead organisms buried for millions of years. All of our food, which provides energy for our bodies, also ultimately comes from plants—whether we eat plants directly or eat other organisms that consume plants and other photosynthesizers.

The element that forms the backbone of all of our fuels, our foods and the bodies of all living things is the simple carbon atom. This element is invisible when it is combined with oxygen to make carbon dioxide gas. Plants and other photosynthetic organisms, such as algae, are able to create food molecules from carbon dioxide, water and energy from the sun. When carbon-containing substances (such as wood, oil, natural gas or coal) are burned, CO_2 is released back into the atmosphere. Similarly, when cells in our bodies use the chemical energy stored in food, CO_2 is released.

Barrier to the Outside World

Even though it is less than one millimeter in thickness, the skin plays an essential role for the body. It protects inner tissues and also provides communication (through the sensory system) with the outside environment. The skin also aids in maintaining a constant temperature within the body. The numerous blood vessels in the skin and sweat glands help cool the body when outside temperatures are warm. When the outside environment is cold and heat must be conserved, blood flow near the surface is reduced, allowing more heat to stay in the body.

The skin is comprised of layers, each with different characteristics. Together, the layers of skin act like thin boards pressed together in a sheet of plywood, giving skin greater strength than it would have otherwise. The upper layer—the epidermis—consists of a layer of living cells and a layer of compacted dead cells. In fact, most of the skin that is visible on our bodies actually consists of dead cells! Skin color is determined by special cells called melanocytes located near the base of the epidermis. The lower layer—the dermis—is fibrous and provides strength to skin. Most nerve receptors that capture information from the outside world are located at the top of the dermis or the base of the epidermis.

Sun and Skin

Skin is especially vulnerable to the effects of ozone depletion in the upper atmosphere. Ultraviolet radiation produced by the sun can damage skin — causing premature wrinkling and loss of elasticity, as well as skin cancer. As increased amounts of UV radiation reach the surface of the planet, the risks for skin damage also increase. Sunburns and suntans both are evidence that skin has been exposed to too much damaging radiation.

4. Burning Curiosity

Background

Most of the fuels that we use come from dead plant or animal matter. The origin of fuel wood, of course, is obvious. However, all of the fossil fuels also are derived from partially decomposed organisms that have been buried at high temperatures and pressures for millions of years. The energy in these fuels originally was captured from the sun during photosynthesis by plants and algae.

When something burns, it combines rapidly with oxygen in a reaction that releases energy. Usually, this energy is given off in the form of heat. Other things are given off at the same time. Carbon dioxide, once trapped by green plants during photosynthesis, is formed again and released back into the atmosphere. Water, also essential for photosynthesis, is released as well.

In addition, most fuels produce substances such as smoke and soot, and other gases like methane and carbon monoxide, when they are burned. Some fuels, such as natural gas, burn much more cleanly than others, such as coal. However, all fossil fuels release carbon back into the atmosphere during combustion.

Links

This activity may be taught along with the following components of the My Home Planet Earth unit.

Adventures:

Mr. Slaptail's Curious Contraption, pages 12–15

Explorations:

Let's Talk About the Atmosphere and Health, pages 2–3

Set-up

The first portion of this activity should be conducted as a teacher demonstration. The second portion may be conducted by students working in groups of 2–4 or as a teacher demonstration.

Procedure

Session 1: What happens when something burns?

1. Have the following materials ready in a demonstration area: large beaker or tempered glass bowl, candle, matches, and several wet paper towels folded together to make a mat larger than the opening of the beaker or bowl.
2. Direct students' attention to the materials that you have gathered. Light the candle and ask, *What is happening to the candle?* After students answer that it is burning, ask, *What do you think it means to burn something? Are we seeing a physical change in the candle or a chemical change?* Remind students that a chemical change produces substances different from the ones that originally were present. Chemical changes usually give off or take in energy.
3. Ask students to predict what might happen if the candle is covered

CONCEPTS

- Burning or combustion takes place when a fuel combines rapidly with oxygen. This is a chemical change.
- When something burns, CO_2, water and other substances are given off.
- Fuels made from living materials contain carbon.

OVERVIEW

By observing a burning candle in a sealed jar and the burning of white sugar, students learn about combustion and energy.

SCIENCE & MATH Skills

- Observing
- Measuring
- Predicting
- Recording observations
- Inferring
- Drawing conclusions

TIME

Preparation: 20 minutes
Class: two sessions of approximately 30 minutes

MATERIALS

For teacher demonstration you will need:

- large beaker or tempered glass ("Pyrex") bowl
- candle
- matches
- wet paper towels

Each group of students will need:

- candle (a short wide candle that does not require support works best)
- small piece of aluminum foil (15 cm square)
- 1/2 teaspoon white sugar
- wet paper towel
- copy of Sugar as Fuel page (one per student or group)

with the beaker. After students respond, place the lighted candle on the wet towels and cover it with the container. Fold the edges of the towels around the lip of the container to create a seal.

4. Have students observe what happens to the candle. The flame will become smaller until it finally extinguishes (this usually takes less than a minute). Ask, *What happened to the candle? Did it run out of material to burn? Do you think it ran out of something else?* Help students understand that the candle ran out of oxygen, one of the gases in air. (Air is explored further in the My Health My World activity "About Air," in the *My World Indoors* unit.)
5. Lift the container slowly and have students observe the other substances present: smoke and condensed water vapor on the sides of the container. Let them examine the blackened candlewick. Ask, *What can we see or feel that was produced by the burning candle?* (heat, water, smoke, charred wick). *What was used by the burning candle?* (melted wax and the wick as fuel, oxygen from air).

Session 2: Sugar as fuel

1. Have the materials managers collect a candle, a square of aluminum foil, a wet paper towel and one or more copies of the "Sugar as Fuel" page. Students should clear all papers and place the candle on the wet toweling in the center of their work area.
2. Let the students create a "testing spoon" by shaping the foil into a spoon-like shape with a long handle (see student page). The bowl of the spoon should be made of only one layer of foil.
3. When they have made the spoon, have one person from each group measure approximately 1/2 teaspoon of sugar into the spoon.
4. Have the students in each group predict what will happen when they heat the sugar over a lighted candle. They should record their predictions on the "Sugar as Fuel" page.
5. Light the candles (which should be placed on the wet paper towels) for each group. Direct the principal investigators to hold the bowls of the testing trays over the candle flames. The other members of the groups should observe and record what happens to the sugar. (The sugar will become liquid, then it will turn amber-colored. This is caramel, similar to the topping used for desserts like flan and custard. Finally, the sugar will burn and become blackened.)
6. Ask, *What happened to the sugar?* Help students recognize that the sugar underwent a physical change (solid to liquid) and a chemical change (burning of liquid sugar). Also ask, *Where did the carbon in the sugar come from?* Lead students to understand that the carbon was taken from air as carbon dioxide during photosynthesis.

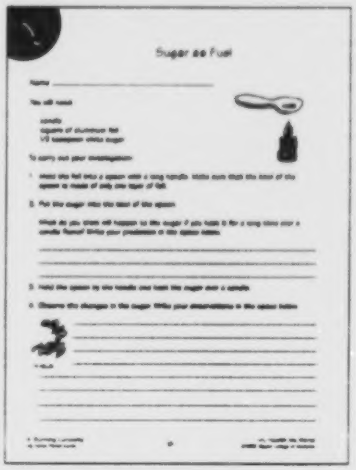
Questions for Students to Think About

- Where does wax come from? How have wax candles been used in the past? Look for answers in the library or Internet.
- All plants make sugar during photosynthesis. Which plants are used for the manufacturing of sweeteners, such as table sugar and syrups?

Clean Fuels

Combustion is a chemical reaction. When something burns, it combines rapidly (sometimes even explosively!) with oxygen. Energy is released in this process, which usually also yields water, carbon dioxide and small amounts of other chemicals.

The ultimate clean-burning fuel is pure hydrogen (H_2), which combines with oxygen to yield only pollution-free water (H_2O). However, practical daily applications of this explosive substance are still being designed.



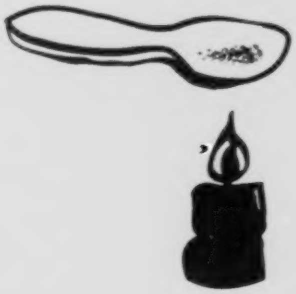
Carbon in Living Things

All living things are made out of molecules containing carbon. Plants take in carbon as carbon dioxide from the air. During photosynthesis, plants make energy-rich molecules, such as sugars, that have carbon as a backbone. Plants and all other organisms use these simple molecules to provide energy and raw materials to manufacture all other substances necessary for life. We can see the evidence of the carbon in sugar as a black residue that appears when the sugar begins to burn.

The formula for table sugar (sucrose) is: $C_{12}H_{22}O_{11}$.

Sugar as Fuel

Name ______________________________



You will need:

candle
square of aluminum foil
1/2 teaspoon white sugar

To carry out your investigation:

1. Mold the foil into a spoon with a long handle. Make sure that the bowl of the spoon is made of only one layer of foil.

2. Put the sugar into the bowl of the spoon.

   What do you think will happen to the sugar if you heat it for a long time over a candle flame? Write your prediction in the space below.

   ____

   ____

   ____

3. Hold the spoon by the handle and heat the sugar over a candle.

4. Observe the changes in the sugar. Write your observations in the space below.

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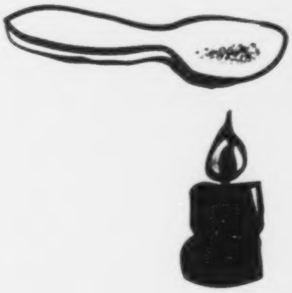
El Azucar como Combustible

Nombre ______________________________

Vas a necesitar:



una vela
un cuadrado de papel de aluminio
1/2 cucharadita de azucar

Para hacer la investigación:

1. Usa el papel de aluminio para formar una cuchara con una asa larga. La parte honda de la cuchara debe de ser construida de una sola capa de papel de aluminio.

2. Pon el azucar en la parte honda de la cuchara.

   ¿Que crees que pasará al azucar si lo calientas por mucho tiempo? Escribe tu predicción en el espacio abajo.

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____
____

3. Toma la cuchara por el asa y calienta el azucar sobre una vela.

4. Observa como cambia el azucar. Escribe tus observaciones en el espacio abajo.

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5. Feeding Frenzy

Background

Some living things, especially plants and algae, are able to build all of the materials that they need from very simple substances. Using energy from light, carbon dioxide and water, these organisms, known collectively as producers, are able to make carbohydrates, which serve as fuel and raw material for the processes of life. All other organisms (consumers) rely on producers for food. Food provides sources of energy and needed raw materials.

When organisms consume food, the food is broken down in order to release energy and to obtain building blocks for other molecules. During this process, oxygen is consumed and some carbon is given off as carbon dioxide. This can be compared to the burning of fuels, which also uses oxygen and releases carbon dioxide. When something burns, most of the energy that is released is given off as heat. Inside living things, some of the energy is used to maintain the body and conduct all of the reactions necessary for life.

All organisms (with a few exceptions) release carbon dioxide when they use food. In mammals, the released carbon dioxide is carried through the bloodstream to the lungs, where it is given off when we breathe out (exhale).

This activity lets students observe how carbon dioxide gas is given off by yeast cells, when they use sugar as food. It uses red cabbage "juice" as an indicator for the presence of carbon dioxide. Cabbage "juice" turns bright pink in the presence of acids, such as the carbonic acid produced by dissolved carbon dioxide in water.

Links

This activity may be taught along with the following components of the My Home Planet Earth unit.

Adventures:
Mr. Slaptail's Curious Contraption, pages 16–20
Explorations:
Riff and Rosie Talk To. . ., page 7

Set-Up

Begin with a demonstration for the entire class. Have students conduct this activity in groups of 2–4. They will need to make observations at 5–10 minute intervals for at least 30 minutes.

Consider having students read part of *Mr. Slaptail's Curious Contraption* or the *Explorations* between observations.

Procedure

Session 1: Making the indicator (can be made in advance)

1. Have the materials managers collect the materials for their groups.
2. Have the students place the sliced red cabbage in the sandwich bags, along with 1/2–1 cup warm water, and seal the bags tightly.

CONCEPTS

- All organisms need a source of energy.
- Plants and some other organisms (producers) take in energy from the sun.
- All other living things rely on producers for energy and raw materials.
- Carbon dioxide usually is given off when living things use food.

OVERVIEW

Students will observe the results of providing yeast cells with a source of food (sugar).

SCIENCE & MATH SKILLS

- Predicting
- Making qualitative observations
- Drawing conclusions

TIME

Preparation: 10 minutes
Class: 15 minutes to make indicator solutions; 15 minutes for demonstration; 30–60 minutes to conduct experiment

MATERIALS

For demonstration you will need:

- zipper-style sandwich bag
- handful of finely sliced red or purple cabbage (raw)
- 1/2–1 cup warm water
- few drops of vinegar
- teaspoon of baking soda

Each group of students will need:

- zipper-style sandwich bag
- handful of finely sliced red or purple cabbage (raw)
- 1/2–1 cup warm water
- teaspoon of dry yeast
- teaspoon of sugar
- 2 clear disposable cups
- 2 stirrers or spoons

Direct them to take turns gently rubbing the cabbage inside the bags until the water becomes dark purple (usually about 10–15 minutes). This is the indicator solution.

Session 2: Demonstration of cabbage juice indicator

1. Tell students that they will be using an indicator to look for the presence of an acid. If students are not familiar with things that are acidic, give them some common examples such as lemon juice and vinegar. Explain that the indicator is going to be used to test for the presence of carbon dioxide, which becomes a weak acid in water.
2. Pour some indicator liquid into a clear cup. Ask, *What color is the liquid? What do you think will happen if I put something acidic in the water?* Add a few drops of vinegar to the solution until it turns pink. You also may show how the indicator solution reacts to bases by adding about 1/2 teaspoon (or more) of baking soda—the solution will turn pale blue or green.
3. Explain to students that they will be using the indicator to test for the presence of carbon dioxide, a gas that is given off when living things use food for energy.

Session 3: Conducting the investigation

1. Talk about yeast with students. Ask, *Did you know that yeast is a living thing?* Direct the students to label the two cups "no food" and "food." Have them divide the warm water equally between the two cups and add 1/2 teaspoon of yeast to each cup.
2. Ask, *Do you think the yeast cells have very much to eat in the cup now?* Help students understand that all living things need food to survive and grow. Ask, *What do you think will happen if we add food for yeast to one of the cups?* Have students record their predictions.
3. Have one person in each group add one teaspoon of sugar to only one of the cups. He or she should swirl or stir the cup gently.
4. Direct the groups to set the cups side-by-side and to observe both cups at 5–10 minute intervals. The yeast in the cup with sugar will begin to produce CO_2 (making the liquid foamy) after a short period of time. As more CO_2 enters the water, the color of the solution will become more pink. Students should stir the cups (with separate stirrers) each time they make their observations.
5. Have students record their observations. (The cup with yeast will be pinker in color than the other cup. In addition, it will be foamy.)
6. Ask, *What happened when you fed the yeast?* Point out that the gas given off by the yeast is the same gas that is given off when wood, coal or oil is burned. Help students understand that the yeast cells were using the sugar as a source of energy.
7. Assess student understanding by having the members of each group write a paragraph describing their investigation and results.

Fuel for Bodies

When sugar is used for energy inside living things, CO_2 is released. This is comparable to what happens when fuels are burned for energy.

Students can observe how they exhale CO_2 by blowing vigorously with a straw into the cup of indicator solution for 5–10 minutes.

Yeastie Beasties

Yeasts are members of the same Kingdom as mushrooms and toadstools. Known as the Fungi, members of this Kingdom are vital as decomposers. They obtain energy and vital nutrients by breaking down the bodies of dead organisms.

Acids and Bases

ACIDS taste sour, conduct electricity and are corrosive. Examples of common acids are vinegar, lemon juice, eyewash solutions (boric acid) and carbonated soft drinks.

BASES have a bitter taste and feel slippery when dissolved in water. Like acids, bases can be very corrosive. Examples of bases include antacids, household ammonia and baking soda.

6. SkinWise

Background

Skin protects inner tissues of the body and also provides communication (through the sensory system) with the outside world. The skin also helps maintain a constant temperature within the body by aiding in cooling—through increased blood flow to the surface and perspiration; and heating—by reducing blood flow near the surface.

The skin is comprised of different layers. The outermost layer, the epidermis, consists of an inner layer of living cells and a top layer of compacted dead cells. In fact, most of the skin that is visible on our bodies actually consists of dead cells! Skin color is determined by special cells called melanocytes located near the base of the epidermis. The lower layer, the dermis, is fibrous and gives strength to skin. Most nerve receptors that capture information from the outside world are located at the top of the dermis or the base of the epidermis.

Skin is especially vulnerable to the effects of ozone depletion in the upper atmosphere. Ultraviolet radiation produced by the sun can damage skin—causing premature wrinkling and loss of elasticity, as well as skin cancer. As increased amounts of UV radiation reach the surface of the planet, the risks for skin damage also increase. Sunburns and suntans both are evidence that skin has been exposed to too much damaging radiation. UV radiation also can harm parts of the eye.

This activity builds awareness of skin by having students contrast and compare the "skin" of an orange to human skin. Students also will compare the surface area of an orange to the area of a person's skin.

Links

This activity may be taught along with the following components of the My Home Planet Earth unit.

Adventures:

Mr. Slaptail's Curious Contraption, pages 21–22
Science box, page 20

Explorations:

What Is It?, page 6; *SkinWise*, page 8

Set-Up

Begin with a discussion involving the entire class. Have students conduct the activity in groups of 2–4.

Procedure

Session 1: Estimating surface area of an orange

1. Generate student interest by brainstorming about things that have a skin. List student ideas on the board. Older students may record the list in their science notebooks.
2. Discuss the purposes of skin and ask for different examples of skin

CONCEPTS

- Skin is a vital part of the body.
- Skin must be protected from sun damage.

OVERVIEW

Students will compare and contrast their own skin (including area) with that of an orange.

SCIENCE & MATERIALS

- Predicting
- Estimating
- Calculating
- Graphing
- Drawing conclusions

TIME

Preparation: 10 minutes
Class: two sessions of 30–60 minutes

MATERIALS

Each group of students will need:

- orange or tangerine
- plastic knife
- paper towels
- 2–3 feet of wax paper
- tape
- crayons or markers
- tape measure
- sheet of paper or notebook for observations
- copy of Graph Paper page (or centimeter ruled graph paper)
- copy of Skin Observations page

Students will estimate the surface area covered by the skin of an orange.

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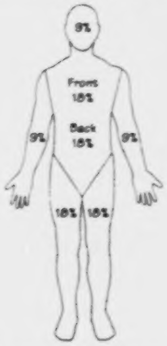
(tree bark, skin on a banana, lizard skin, bird skin, etc.) based on the list of things with skins.

3. Holding an orange, explain to students that they will be examining the skin of an orange and comparing it with their own skin. Ask, *How is the skin of an orange like your skin? How is it different?*
4. Have materials managers collect materials for the groups. Each group will need: an orange, paper towels, plastic knife, tape measure, sheet of writing or notebook paper, and two or more sheets of centimeter square graph paper.
5. Begin the group activity by having one student (recorder) list the group's observations about the skin of the orange. Then place a check next to the observations that would be the same for human skin.
6. Next, ask, *How much skin does an orange have? How could we find out?* Instruct students to estimate the amount of skin on the oranges by coloring similar areas on their graph sheets. They may want to measure their oranges using tape measures. With older students, use this opportunity to investigate the relationships among diameter, circumference and area.
7. Ask, *How could you check your estimates?* Have students peel the oranges and, within each group, trace the peelings onto graph paper. Have them color the traced areas orange. Have students count the number of squares that are colored and decide how much skin their orange really had. Let students devise their own methods for counting partially colored squares, or instruct them to count every other partial square. Ask, *Are you surprised about the area covered by the skin? Why or why not?*
8. Next, have the students examine the peeled oranges. Discuss what might happen if oranges didn't have skin.

Session 2: Estimating the amount of skin on a person

1. Explain that, just like oranges, our bodies need protection. Mention some of the characteristics of skin: skin is the body's largest organ; skin provides strong protection from germs; skin houses our cooling and heating systems; skin contains receptors for our sense of touch, etc. Refer students to the diagram of skin on page 8 of the *Explorations* mini-magazine.
2. Ask, *How much skin do you have and how do you protect it?* Students can record their estimates in their science notebooks and list ways they protect their skin.
3. Tell students that the area of skin on the body can be measured with relative accuracy by applying the Law of Nines. This rule of thumb was developed to help doctors estimate the amount of skin damaged in people with burns. Roughly, each of the 11 major sections of skin on the body accounts for 9% (or 1/11) of the total. Using this rule, students can estimate the total surface area of skin by measuring the area of one arm.
4. Working in teams of two, have one student wrap another's arm in

Law of Nines



Each of the major parts of the body represents about 9% or 1/11 of the total amount of skin.

Front of each leg	9%
Back of each leg	9%
Each arm	9%
Head	9%
Each half of front torso	9%
Each half of back torso	9%

Many aspects of circles and spheres are described mathematically using radius (r) and π.

$2r$ = diameter

$2\pi r$ = circumference

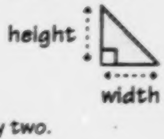
$4/3\pi r^2$ = surface area of a sphere

$4/3\pi r^3$ = volume of a sphere

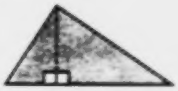
The area of an irregular geometric shape with straight sides can be estimated by dividing the shape into one or more rectangles and/or triangles. Find the area of each of the smaller shapes and sum the individual areas to find the total area.

To find the area of a rectangle, multiply height times width.

To find the area of a right triangle (a triangle with a 90° angle) multiply height times width and divide the result by two.



Divide other kinds of triangles into two right triangles and calculate the areas as above.



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wax paper. Have them mark any areas of overlap, so that they will not be counted for the estimate of surface area.

5. Have them spread the paper out over two or more sheets of centimeter graph paper and count the number of squares (or have older students measure the dimensions of the wax paper and calculate the area as if it were a rectangle, or a rectangle and one or more triangles).
6. Once students have found the surface area of an arm, have them multiply that figure by 11 to obtain the total surface area of skin on the entire body.
7. Ask students to imagine how they might look and feel without their skin—just like the peeled orange. Mention the importance of protecting skin from damaging radiation (ultraviolet) from the sun. Discuss strategies for protecting skin, including wearing clothes with long sleeves, always applying sunscreen, wearing hats, etc.

Variations

- Wrap the entire body of one or more students in wax paper, then spread the paper out and measure its area. Compare the result to the estimate using the area of only one arm.
- Have students calculate the area covered by a t-shirt, shorts, bathing suit or other clothing. Challenge them to figure out the amounts of skin that are exposed when wearing short sleeves and shorts instead of long sleeves and trousers.

Questions for Students to Think About

- Read about ozone depletion and the role of CFCs (chlorofluorocarbons) on page 3 of the *Explorations* mini-magazine for this unit. What else can you find out about the ozone layer? What is being done to protect this vital part of the atmosphere?

Sunscreens

Commercial sunscreens protect the skin by shielding it from UV radiation. The most effective products are thick creams, like zinc oxide or titanium oxide, that do not let any radiation pass through to the skin.

Many sunscreens contain a chemical known as PABA (p-aminobenzoic acid). This often is used in tanning lotions, because it lets some of the longer wavelengths of UV light through. The skin reacts to the UV light by creating a protective layer of pigment. Unfortunately, even a tan that is acquired slowly with the benefit of tanning lotion still is evidence of skin damage that eventually could lead to premature aging and/or skin cancer.

Other sunscreens with compounds such as benzophenone and dioxybenxone provide protection against all wavelengths of UV light.

The "Sunscreen Protection Factor" (SPF) of a lotion serves as a measure of its protecting power. A product with an SPF of 10 reduces the the amount of radiation reaching the skin by a factor of 10. Most experts recommend that products with an SPF of at least 15 be applied daily. People with fair skin should use sunscreens with an SPF of at least 30.

Did you know that hair, feathers, scales, claws, hooves and fingernails all are part of skin?

Centimeter Graph Paper
Papel Cuadriculado

Name/Nombre ______________________________

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Skin Observations

Name ____

Skin of an Orange

1. Observe the skin of an orange. Write your observations on a separate sheet of paper.
2. Put a check beside the observations that are the same for human skin.
3. How much skin do you think is on an orange? Write your prediction beneath your observations.
4. Now, peel an orange and lay the pieces of skin on graph paper.
5. Trace around the pieces and color in the spaces that were covered by the orange skin.
6. Count the number of squares that are colored. How many centimeter squares did you count? Write the number here.

Area of skin on orange = ______________________ cm^2

My Skin

1. How much skin do you think is on a person? Write your prediction beneath your predictions for the skin of an orange.
2. Wrap your partner's arm in wax paper—making sure to just cover the arm.
3. Lay the wax paper over graph paper and count the squares that are covered. This is the number of square centimeters of skin on your arm. Write the number here.

Area of skin on arm = ________________________ cm^2

4. Multiply this number by 11 to figure out the total area of skin on the body.

☐ cm^2 × 11 = ☐ cm^2

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Observaciones sobre la Piel

Nombre ______________________________

Piel de una Naranja

1. Observa la piel de una naranja. Escribe tus observaciones en una hoja de papel.

2. Marca las observaciones que son iguales para la piel humana.

3. ¿Que tanta piel crees que tenga una naranja? Escribe tu predicción abajo de tus observaciones.

4. Ahora, pela la naranja y coloca los pedazos sobre el papel cuadriculado.

5. Traza alrededor de los pedazos y colorea los espacios cubiertos por la piel de naranja.

6. Cuenta el número de cuadros que están pintados. ¿Cuantos cuadros de un centímetro contaste? Escribe el número aquí.

Area de la piel de una naranja = ____________________ cm^2

Mi Piel

1. ¿Que tanta piel crees que tenga una persona? Escribe tu predicción abajo de tu predicción de la piel de una naranja.

2. Envuelve el brazo de tu pareja en papel encerado — cuidando de cubrir justo el brazo.

3. Coloca el papel encerado sobre una hoja de papel cuadriculado y cuenta el número de cuadros que están cubiertos. Esto es el número de centímetros cuadrados de piel que hay en un brazo. Escribe el número aquí.

Area de la piel del brazo = ____________________ cm^2

4. Multiplica este número por 11 para obtener el área total del cuerpo cubierto por la piel.

☐ cm^2 × 11 = ☐ cm^2

Environmental Health Basics

People and Global Change

Earth's Special Atmosphere

Life on Earth has been possible because of the very special characteristics of our atmosphere. The atmosphere keeps the planet warm enough to support life, thanks to the presence of certain gases in the lower atmosphere. The atmosphere also absorbs almost all of the potentially damaging ultraviolet (UV) light produced by the sun before it reaches the surface. Our atmosphere contains elements necessary for life—nitrogen, carbon and oxygen—as well as abundant water vapor to maintain the water cycle.

Human actions, particularly during the last several decades, are changing the composition of the Earth's atmosphere. Since the industrial revolution, people have been removing stored carbon from the Earth in the forms of coal, crude oil and natural gas, and burning it to make heat. In the process, water vapor, carbon dioxide and small amounts of other substances are produced. Other activities, such as clearing land (by burning) for agriculture also have added CO_2 to the atmosphere. As a result, levels of carbon dioxide in the lower atmosphere have increased from around 260 parts per million (ppm) by weight to over 350 ppm.

Carbon dioxide is one of the gases responsible for trapping heat near the the Earth's surface and lower atmosphere. Scientists believe that increases in the amounts of CO_2 and other greenhouse gases could lead to warmer temperatures on the planet. Even minor increases in the surface temperature of the planet could have far reaching effects. Major climatic patterns of winds, temperature and rainfall could change drastically. This would impact water resources, coastlines, agriculture, forests, energy production and patterns of disease.

We Depend on the Climate

Climate, the characteristics of the weather in a particular region over long periods of time, determines which kinds of plant and animal life are present, which crops can be grown, how people construct their houses and, to a great extent, people's clothing and diet. The climate of a particular region depends on distance from the equator, altitude and rainfall patterns.

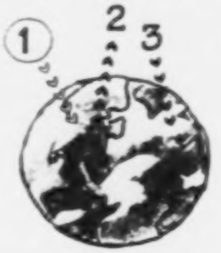
Even slight changes in the world's climate would impact human health and well-being in countless ways.

CFCs and Ozone

The release of chemicals known as CFCs (chlorofluorocarbons) also is contributing to changes in the atmosphere that will affect climate and human health and well-being. Freon and other CFCs are greenhouse gases and contribute to the trapping of heat near the surface of the Earth. In addition, chlorine molecules released by these chemicals in the stratosphere break apart the ozone molecules that are responsible for shielding the Earth from ultraviolet radiation.

Over the last decade, the amount of ozone in the stratosphere has decreased (especially in the polar regions)—leading to greater risks of skin cancer for people and also damaging vital populations of plants, animals and marine life.

The *Greenhouse* Effect



1. *Sunlight passes through the clear atmosphere and warms the Earth's surface.*
2. *The surface gives off some heat that goes back into the atmosphere. Some of it passes through and escapes into space.*
3. *Greenhouse gases and water vapor trap some of the heat, and give it off again toward the Earth.*

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7. Enlightening

Background

We seldom think about the importance of the sun to our planet. It is the ultimate source of almost all the energy we use. Besides the sun, the only other sources of energy on the planet are radioactive rocks and the molten rocks deep below the surface. The sun keeps us warm. It is responsible for weather, which is caused by uneven heating of large areas of air. Our food and common fuel sources depend on solar energy trapped by producers such as plants.

This activity is designed to build student awareness of the importance of the sun as the source of almost all energy on Earth. It also provides insight into harnessing the sun's power directly as a source of energy, as was accomplished by Mr. Slaptail's solar water heater in the adventure story that accompanies this unit.

Links

This activity may be taught along with the following components of the My Home Planet Earth unit.

Adventures:
Mr. Slaptail's Curious Contraption, pages 22–24
Science box, page 20
Explorations:
Sun Power, page 4; *We Can Make a Difference!*, page 5

Set-Up

Place all materials in a central area for materials managers to collect for their groups. Have students work in groups of four to conduct the activity.

If you are teaching this activity during the winter, you will need to conduct the activity indoors. When the weather is warm, students may conduct the experiment outside.

Procedure

1. Have each group of students label two identical cups as "light" and "dark." Next, have them measure 50 mL of water into each of the cups.
2. Direct the students to measure the temperature of the water in each of the cups and to record it on their student sheets.
3. Have each group place the cup labeled "light" in direct sunlight (outside or inside the classroom). The other cup should be left inside the classroom, preferably in a dark area of the room away from any heating vents or radiators.
4. If possible, have students wait at least one hour before checking the "light" cup. Have them measure the temperature of the water in the cup and record it on their sheet. Afterward, have them measure the temperature of the water in the "dark" cup and record their observations.

CONCEPTS

- Some of the energy given off by the sun can be felt as heat.
- Heat from the sun can be used as a source of energy.

OVERVIEW

Students conduct a discovery activity that allows them to observe how energy from sunlight can heat water.

SCIENCE & MATH

- Measuring liquids and solids
- Predicting
- Observing
- Drawing conclusions

TIME

Preparation: 10 minutes
Class: 30–60 minutes

MATERIALS

Each group of students will need:

- 2 identical plastic cups
- graduated cylinder or metric measuring cup
- unbreakable thermometer
- copies of Sunlight Observations sheet

5. Ask, *What happened to the water in the cup that you placed in the sun? Did it become warmer or colder? What about the water in the cup you left inside?* Help students understand that energy from the sun warmed the water in the cup exposed to the sun. Ask, *Where are other places that we can observe energy from the sun?*

Variations

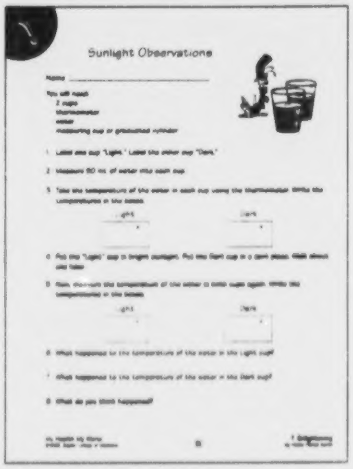
- Have students compare the effects of using different colored cups for absorbing heat from sunlight, or the effects of placing the cups on a reflector made of aluminum foil, or on black paper (which absorbs heat).
- Challenge students to come up with their own designs for solar water heaters. Let them create drawings of their designs and/or build their heaters from recycled materials

Questions for Students to Think About

- In the story, *Mr. Slaptail's Curious Contraption*, Mr. Slaptail builds a solar water heater to supply his house with hot water. Do you think that this is a practical use of solar power? See what you can find out about houses that use power from the sun for heat, electricity or hot water, by checking the library or searching the Internet.

Measuring Heat Energy

Did you know that heat energy is measured in calories? One calorie represents the amount of heat that it takes to raise the temperature of 1 cubic centimeter of water (10 miliiliters) 1 *degree*.



Sunlight Observations

Even fossil fuels, energy sources that we use every day, owe their existence to the sun. They were formed from partially rotted plants and tiny living things that were buried at intense pressures for millions of years.

Sunlight Observations

Name ________________________________

You will need:
- 2 cups
- thermometer
- water
- measuring cup or graduated cylinder

1. Label one cup "Light." Label the other cup "Dark."
2. Measure 50 mL of water into each cup.
3. Take the temperature of the water in each cup using the thermometer. Write the temperatures in the boxes.

Light	Dark
°	°

4. Put the "Light" cup in bright sunlight. Put the Dark cup in a dark place. Wait about one hour.
5. Now, measure the temperature of the water in both cups again. Write the temperatures in the boxes.

Light	Dark
°	°

6. What happened to the temperature of the water in the Light cup?
7. What happened to the temperature of the water in the Dark cup?
8. What do you think happened?

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42

Observaciones Solares

Nombre ________________________________

Vas a necesitar:
- 2 vasos
- termómetro
- agua
- taza o cilíndro para medir

1. Marca un vaso "Luz." Marca el otro "Sombra."

2. Mide 50 mL de agua en cada vaso.

3. Mide la temperatura en cada vaso usando el termómetro. Escribe las temperaturas en los cuadros.

Light	Dark
°	°

4. Pon el vaso "Luz" en el sol. Pon el vaso "Sombra" en algun lugar obscuro. Espera una hora.

5. Ahora, mide la temperatura del agua en ambos vasos otra vez. Escribe las temperaturas en los cuadros.

Light	Dark
°	°

6. ¿Que pasó con la temperatura del agua en el vaso con luz?

7. ¿Que pasó con la temperatura del agua en el vaso con sombra?

8. ¿Que crees que pasó?

8. Solar S'Mores

Background

Several transparent gases in the lower layer of the atmosphere (troposphere) have an important role in determining the temperature of the Earth's surface. These gases, which act like glass windows in a greenhouse or automobile, let light and other forms of radiation from the sun pass through the atmosphere. Much of this energy is absorbed by the Earth's surface, which becomes warmer (just like the seats in a car parked in the sun). Some heat, however, also is radiated back into the atmosphere. There, gases like carbon dioxide, methane, ozone and water vapor (the so-called "greenhouse gases") absorb some of the heat and sent it out again in all directions, including back toward the surface. The effect of this is to warm the Earth's surface and the lower atmosphere.

Without the warming effect of the greenhouse gases, the average surface temperature of the Earth would be around 18°C (0°F), instead of the actual temperature of about 15°C (59°F). Much of the planet would be frozen. On the other hand, if there were much more of the greenhouse gases, the surface of the Earth would be too hot to support life.

Scientists around the world are concerned that increased levels of greenhouse gases (especially carbon dioxide), resulting from human activities, will cause additional warming of the surface of the Earth. Levels of carbon dioxide in the atmosphere have increased more than 30% since the industrial revolution. This increase is due primarily to widespread uses of fossil fuels and changes in land use (burning forests to clear land for farming, for example).

Even minor increases in the surface temperature of the planet could have far-reaching effects. Major climatic patterns of winds, temperature and rainfall could change drastically. This would impact water resources, coastlines, agriculture, forests and energy production, as well as patterns of disease.

This activity is designed to provide a simple introduction to the concepts underlying the greenhouse effect and to provide background information for thinking about climate change.

Links

This activity may be taught along with the following components of the My Home Planet Earth unit.

Adventures:

Mr. Slaptail's Curious Contraption, pages 24–27, 30–31

Explorations:

Not Such a New Issue, page 6; *Riff and Rosie Talk To. . .*, page 7

Set-Up

Place all materials in a central area for materials managers to collect for their groups. Have students work in groups of four.

CONCEPTS

- Different materials absorb and trap heat differently.
- Some materials allow light to pass through, but do not let heat escape.

OVERVIEW

Students will be able to observe how some transparent materials allow light to pass through, but do not let heat escape. This will provide background for understanding the role of heat-trapping gases in the atmosphere ("greenhouse effect").

SCIENCE & MATH SKILLS

- Predicting
- Observing
- Modeling
- Drawing conclusions

TIME

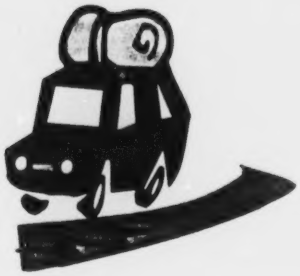
Preparation: 10 minutes
Class: 30 – 60 minutes

MATERIALS

Each group of students will need:

- 4 identical plastic cups
- 4 plain round cookies
- 4 chocolate candies ("kisses" or squares)
- 1/4 cup of marshmallow creme or frosting
- plastic knife or spreader
- sheet of black paper
- sheet of white paper
- sheet of aluminum foil (approximately 12 inches or 30 cm square)
- tape or stapler
- large paper plate or tray

If you are teaching this lesson during the winter, you will need to conduct the activity indoors. When the weather is warm, students may conduct the experiment outside in an area that is protected from the wind.

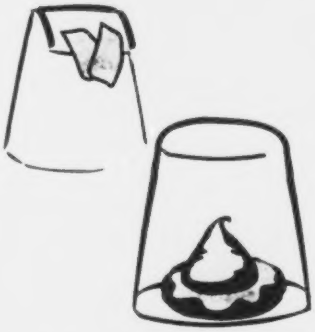


The windows of an automobile let sunlight through, but do not allow heated air to escape.

Procedure

1. Ask students, *Have you ever noticed how warm a car can become when it is parked in the sun? Where do you think the heat inside the car comes from?* Mention that they will be conducting an investigation to learn more about heat and light.
2. Give four clear plastic cups to each group of students. Have them label the cups: "clear," "black," "white" and "shiny."
3. Using construction paper, have the students construct a white paper cover for the cup labeled "white," a black paper cover for the cup labeled "black," and a cover of aluminum foil for the cup labeled "shiny." You may want to have students identify which of the cup treatments are transparent, and which are opaque.

   One way to make a cover is by rolling the sheet of paper into a tube that will fit around the cup. Fold and tape (or staple) the top of the tube and place it over a cup. You may want to challenge students to create their own standard covers for the cups. The cup labeled "clear" will have no cover.
4. After students have labeled the cups and made covers for three of the cups, have the materials managers from each group pick up four round cookies, four chocolate candies, a spreader and a small container of marshmallow cream or frosting.
5. Tell students that they will be investigating how well the different cups and covers trap heat by making Solar S'Mores. Each student will create one S'More by placing a small amount of marshmallow cream or frosting on the cookie, followed by a chocolate candy.
6. Direct the students in each group to place the cookies on a plate or tray and to cover each of the cookies with one of the cups. (If the experiment will be conducted outside, have students tape the cups to the plate.) Have students predict which treatment will melt the chocolate candy the most, and which treatment will have the least melted chocolate.
7. Have students place the plates and cups in a sunny spot near a window, or outside in direct sunlight, preferably on a lawn. (Do not place the plates on hot pavement in the sun. The heat from the already warm surface will affect the results.)
8. Let students make their first observations after about 15 minutes. Depending on the temperature of the air, some of the chocolate candies may begin to soften at this time. Continue observing at 10–15 minute intervals, until at least one of the candies has become very soft. (Note: some chocolate candies will be very soft and still hold their shape.)
9. Have students bring their plates indoors and make observations



Students will create covers of different materials for cups containing "Solar S'Mores."

To conduct the activity indoors, use a heat lamp or place the Solar S'Mores in a sunny window.

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on the condition of each of the four chocolate candies. Ask students to rank the candies from most melted to least melted—giving a score of "1" to the least melted and a score of "4" to the most melted.

10. Make a chart (as shown on the right) on the board and let each group report its results.

	TREATMENT			
	Clear	Foil	Black	White
Group 1	4	1	3	2
Group 2	4	1	2	3
Group 3	3	2	4	1
Group 4				
Group 5				
Group 6				
TOTAL				

11. Add (or have students add) all of the points received by each treatment. Usually, the clear cup treatment will have the most points (meaning that the clear cup melted the chocolate the most), and the foil will have the fewest points (least melted chocolate). Because the observations are subjective, there usually will be some discrepancies among the results reported by each of the groups. Use this as an opportunity to point out the importance of conducting an experiment more than once.
12. Discuss the results of the experiment with the class. Ask, *Which kind of cup melted the chocolate the most? The least? Why do you think so?* Help students understand that the most light energy was able to pass through the clear cup. Much of this energy was transformed into heat. In the case of the cup covered with foil, more light energy was reflected away from the cup. The white paper reflected some of the light energy away. The black paper absorbed more energy than the white cup.
13. Let each student eat his or her S'More, while you lead a discussion connecting their observations to what happens inside a car parked in the sun. You also may want to refer to page 9 in the story, *Mr. Slaptail's Curious Contraption*, in which Riff and Rosie share a glass of lemonade with Mr. Slaptail in his greenhouse. Help students understand that certain gases in the atmosphere, especially carbon dioxide, act like the clear cups in their experiments. These gases keep the surface of the planet warmer than it would be otherwise.

The results of an investigation often vary due to factors, known and unknown, that cannot be controlled by the student or investigator. Because of this variability, scientists use several to many experimental groups and repeat their experiments. In this way, it becomes possible to estimate the amount of variability present and make predictions about the consistency of the results.

Variations

- Before beginning, have students create a class chart of their predictions about the results of the investigation. Compare the predictions to the results and discuss the differences with students.

Questions for Students to Think About

- The levels of some heat-trapping gases (especially carbon dioxide, methane and ozone) have increased in the atmosphere during the last several decades. Many scientists believe that these increases in the amounts of greenhouse gases could cause additional warming of the Earth's surface. Based on what you have observed, do you think that this is a reasonable question to ask? What other information can you find about this topic in the library or on the Internet?
- Based on what you have learned in this activity, how do you think Mr. Slaptail might have improved upon the design of his contraption?

9. People and Climate

Background

While we often don't think about it, many aspects of life are determined by climate. Climate, the characteristics of the weather in a particular region over long periods of time, determines which kinds of plant and animal life are present, which crops can be grown, how people build their houses and, to a great extent, people's clothing and diet.

There are three major climate zones on the planet. They are determined by distance from the equator. The zone near the equator—the tropical zone—is warmest because it is slightly closer to the sun and receives more direct radiation. The zones closest to each of the poles—the polar zones—are the coldest, because they are farthest from the sun and receive less direct radiation. The broad areas between the tropical and polar zones—known as the temperate zones—generally have snow or rain during cool or very cold winters. The temperate zones lie between 30° and 60° latitude in both hemispheres.

Other factors also affect the climate of a particular region. Nearness to an ocean usually keeps temperatures cooler in summer and warmer in winter. Altitude also influences temperature; mountainous areas frequently are colder than sea-level regions at the same latitude. In addition, rainfall varies from region to region depending on wind patterns and characteristics of the land. Some parts of the world receive little or no rainfall. Most of these desert areas are located near or within the tropical zone. Other parts of the tropical zone receive large amounts of rain during certain seasons.

Many scientists are concerned that human activities during the last century will modify the Earth's climate. The addition of greenhouse gases such as carbon dioxide may lead to increases in global temperatures. This could cause changes in rainfall and temperature in many parts of the planet, with enormous consequences for ecosystems, cities and agriculture.

The release of chemicals known as CFCs (chlorofluorocarbons) also is contributing to changes in the atmosphere that will affect climate and human health. Freon and other CFCs are greenhouse gases and contribute to the trapping of heat near the surface. In addition, chlorine molecules released by these chemicals in the stratosphere break apart the ozone molecules that are responsible for shielding the Earth from ultraviolet radiation. Over the last decade, the amount of ozone in the stratosphere has decreased (especially in the polar regions)—leading to greater risks of skin cancer for people and also damaging vital populations of plants, animals and marine life.

This activity is designed to help students become aware of how the climate of a region influences all aspects of people's lives.

CONCEPTS

- Major climate zones are determined by distance from the equator (and angle of light received from the sun).
- Rainfall also is an important part of climate.
- Climate affects all aspects of human life.

OVERVIEW

Students will learn about the major climate types on Earth and how they affect people's lifestyles.

SCIENCE & MATH SKILLS

- Observing
- Modeling
- Inferring
- Using maps
- Drawing conclusions

TIME

Preparation: 10 minutes
Class: Two or more sessions of 30–60 minutes

MATERIALS

For demonstration, you will need:

- flashlight
- large inflated balloon, ball or globe

Each group of students will need:

- large sheet of paper or poster board
- several sheets of construction paper in different colors
- glue or paste
- one or more copies of Global Climate Map on page 39

Links

This activity may be taught along with the following components of the My Home Planet Earth unit.

Adventures:
Mr. Slaptail's Curious Contraption, Science boxes, page 27–29
Explorations:
Cover activity; *What Is Climate?*, page 2

Set-Up

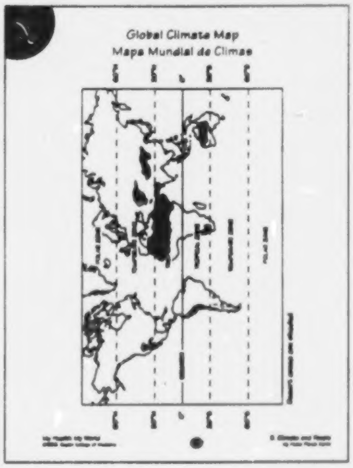
Begin the activity with a whole-class discussion, followed by the students working in groups of four.

Procedure

1. Darken the room and shine a flashlight at the center of a balloon or large ball. Ask, *If the balloon represents the Earth and the flashlight represents the sun, which part of the Earth receives the most direct light and heat from the sun?* Help students see that the central part of the planet (near the equator) is closer to, and receives light at a more direct angle from the sun. Follow by asking, *Which part of the Earth do you think might be warmest? Coldest? Why?*
2. Distribute copies of the Global Climate Map to each student or group of students. Help them find the equator and relate it to the central portion of the balloon or ball that you used for the demonstration. Ask, *Would the equator be the warmest or coldest part of the planet?* Next, help students identify the polar regions and the temperate regions.
3. Ask, *Is temperature the only important part of weather?* Lead students to understand that rainfall also is an important part of weather and climate. If students are not familiar with the concept of climate, introduce the idea at this point. *The normal weather that we find in a region over long periods of time is called climate. What is our climate like?* Encourage a discussion of the characteristics of the climate in which you live (kind of winters, amounts of rainfall, temperatures in summer, etc.).
4. Point out that regions with very little rainfall (deserts) also are shown on the Global Climate Map.
5. Assign a climate zone and geographic area shown on the student page to each group of students. Examples include: temperate zone of North America; tropical zone of South America; tropical desert zone of Africa; and so forth. Give more explicit geographic locations (by country or region) to older students, and have them use outside resources for additional information. Explain that they will be thinking about how people might live in the given climate type. Have each group discuss and decide the types of clothing that people might wear in summer and winter (if the climate has changes in the seasons), what the houses might look like, and what types of foods people might eat. Refer students to the cover of the *Explorations* mini-magazine accompanying this unit for

Temperature at High Altitudes

Air temperatures are colder at higher altitudes because most heat on the planet is held near ground level. In fact, some mountains near the equator have snow at the top all year long.



Seasons

The Earth is tilted as it revolves around the sun. When the Northern Hemisphere is tilted toward the sun, that half of the Earth has summer and the Southern Hemisphere has winter.

ideas. Older students may want to use resources in the library or on the Internet for this activity.

6. Have each group write a description of how people live in their region and climate. Then, have each group create a "torn paper art" picture of people and houses for their climate on a large sheet of paper or poster board. To create "torn paper art," have students use only pieces of construction paper torn to any size, pasted onto a background, to make their pictures.
7. Display the written descriptions and pictures in the classroom.

Variations

- The distribution of plants and animals on the planet is determined largely by climate. Have students find out about the principal plant and animal communities in their assigned climate zones and regions.
- Instead of using "torn paper art," have students choose the medium they will use to create their presentations.
- Have each student group select a city from around the world, identify where the city would fall in the Global Climate Map, and then conduct their research on the climate and lifestyles of people living in that specific city.

Questions for Students to Think About

- What kinds of changes would people have to make in their lifestyles, if the predictions of global warming are accurate? Do you think that something that affects the Earth's atmosphere will impact just certain regions or will it affect everyone?

Reductions in the amount of ozone in the stratosphere are allowing more ultraviolet radiation from the sun to reach Earth's surface. Ultraviolet (UV) radiation is that portion of the electromagnetic spectrum just beyond visible light with wavelengths between 200 and 400 nanometers. UV radiation damages living cells by disrupting DNA and proteins. The effects of some kinds of UV exposure are cumulative and may not show up for many years. In humans, increased exposure to UV radiation (especially UV-B, with wavelengths between 290–320 nanometers) is linked to skin cancer, the development of cataracts and effects on the immune system. UV-B radiation also is toxic to plants, including crop plants, and phytoplankton, which forms the basis of marine food chains.

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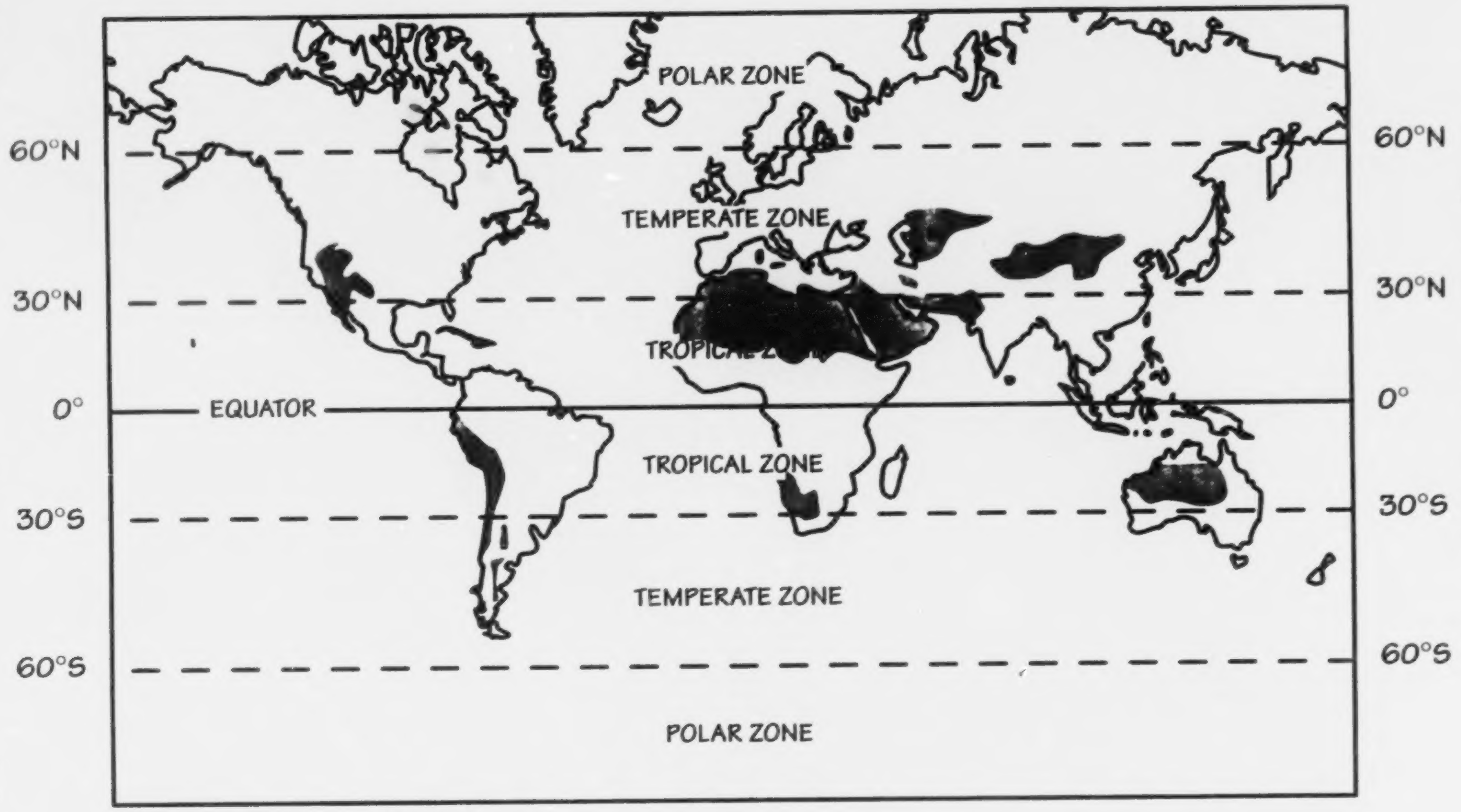
Global Climate Map
Mapa Mundial de Climas


POLAR ZONE
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60°S
60°S
POLAR ZONE

Desert areas are shaded

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10. Everyone Counts

Background

For the first time in history, human actions are changing the composition of the Earth's atmosphere on a global scale. Increases in the levels of heat-trapping greenhouse gases (especially carbon dioxide) and decreases in the amounts of stratospheric ozone both have been measured. These processes have the potential to impact human well-being in countless ways.

This activity is designed to assess student understanding of concepts related to global atmospheric change as presented throughout this unit. Each student will write a persuasive letter about a topic related to protecting the atmosphere and protecting human health.

Links

This activity may be taught along with the following components of the My Home Planet Earth unit.

Adventures:
Mr. Slaptail's Curious Contraption, review all Science boxes
Explorations:
Tips for Healthy Living, page 3

Set-up

Begin the activity with a whole-class discussion, followed by students working individually.

Procedure

1. Review the importance of our global environment to individual health and to the health of the planet. You may use the *Tips for Healthy Living* on page 3 of *Explorations* or pages 34–35 in *Mr. Slaptail's Curious Contraption*, or a review of the activities in this unit to guide students.
2. Explain to students that they will be writing a persuasive letter to another student. (This would be a good time to review or introduce letter writing skills.) Each student should select one of the issues presented in this unit and try to convince someone to help protect the atmosphere, themselves or a friend, with regard to global atmospheric change.
3. Encourage the students to create stationery that represents "My Home Planet Earth" for their letters.

Variations

- Students may want to discuss important issues in groups before beginning their individual letters.

CONCEPTS

- Students are able to make a difference in their own health and that of the planet.

OVERVIEW

Students will review ideas covered in this unit and reach conclusions regarding the importance of the global environment and their health.

SCIENCE & MATH SKILL

- Comparing
- Identifying relationships
- Inferring
- Applying prior knowledge to new situations

TIME

Preparation: 10 minutes
Class: 45 minutes

MATERIALS

Each group of students will need:

- crayons or markers
- pencils or pens
- drawing paper

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MY HEALTH MY WORLD
MY HOME PLANET EARTH

MR. SLAPTAIL'S CURIOUS CONTRAPTION

RIFF AND ROSIE

Written by Barbara Tharp, Judith Dresden and Nancy Moreno
Illustrated by T Lewis

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My Health My World® Adventures

MR. SLAPTAIL'S CURIOUS CONTRAPTION

by

Barbara Tharp, Judith Dresden and Nancy Moreno
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illustrated by

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WOW Publications
Houston

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Judith Dresden, M.S.
Barbara Tharp, M.S.
Celia Clay, M.P.H.

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Contents

The Project 1

Sun Power 6

KABOOM! 10

Off to the Coal Mine 12

To the Rescue 16

Ms. Diggerpaw's Decision 21

Rosie's Idea 22

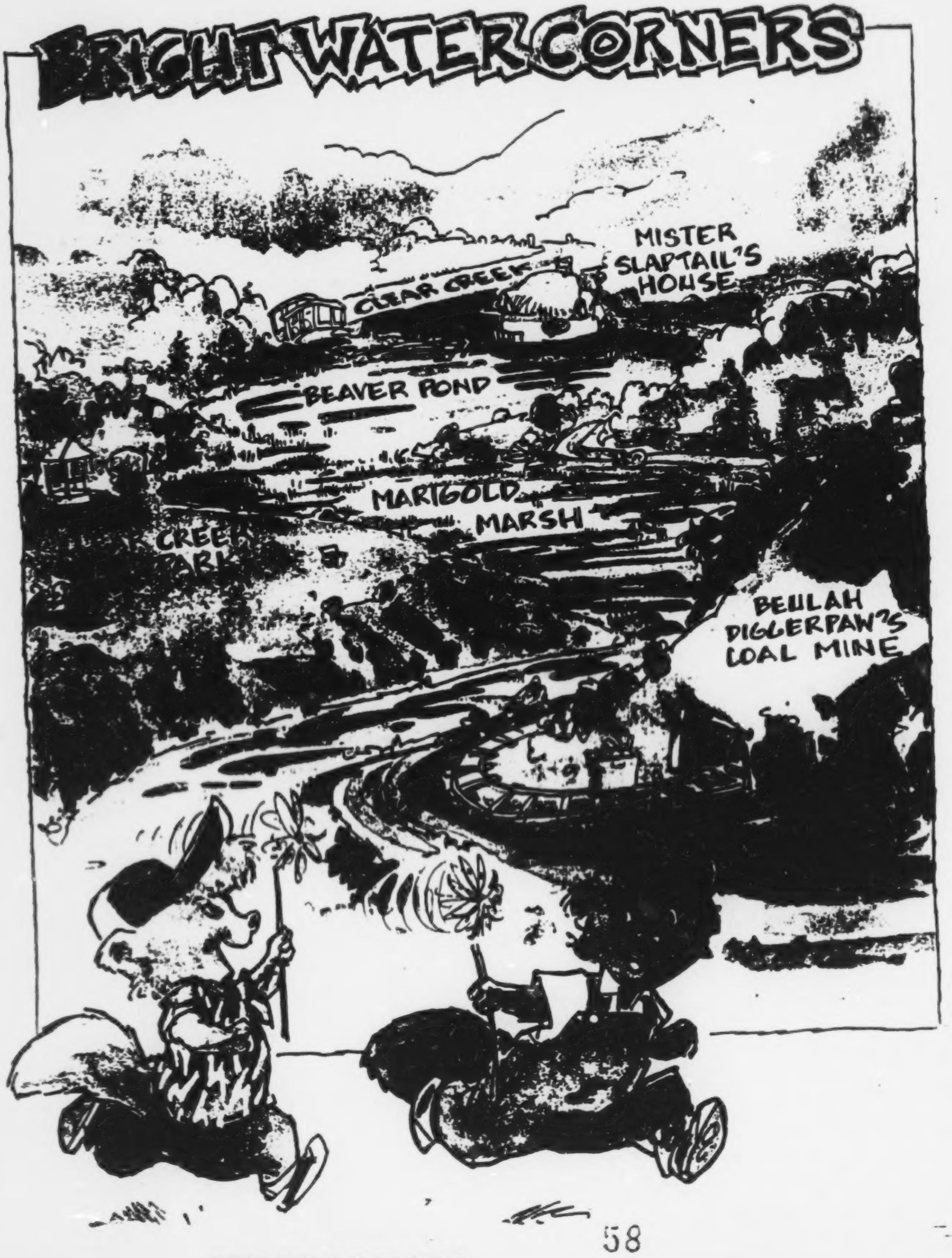
Only the Beginning 24

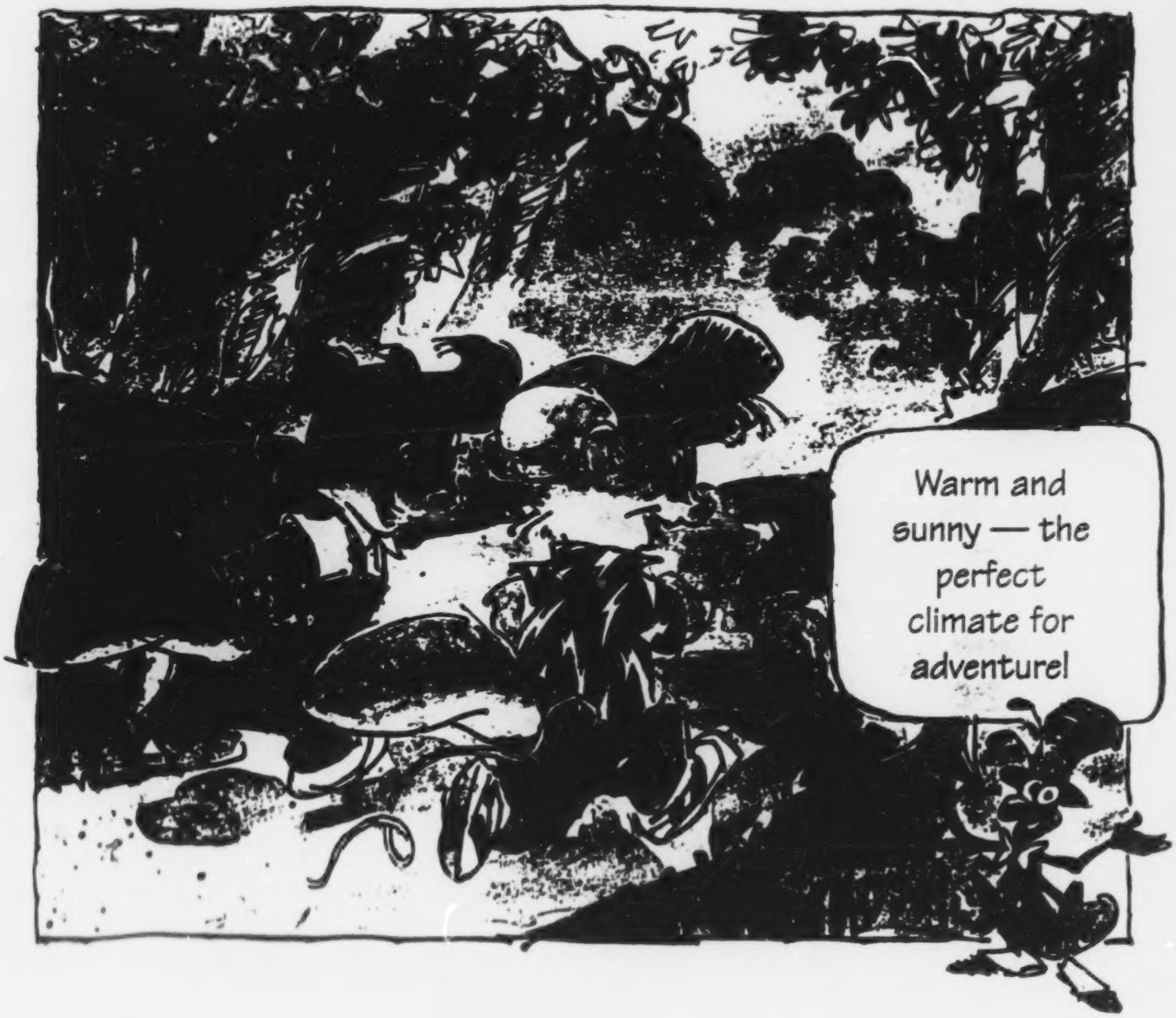
Up on the Roof 30

……

How to Make a Pinwheel 32

Glossary 33


BRIGHT WATER CORNERS
CLEAR CREEK
MISTER SLAPTAIL'S HOUSE
BEAVER POND
MARIGOLD MARSH
CREEK PARK
BEULAH DIGGERPAW'S COAL MINE

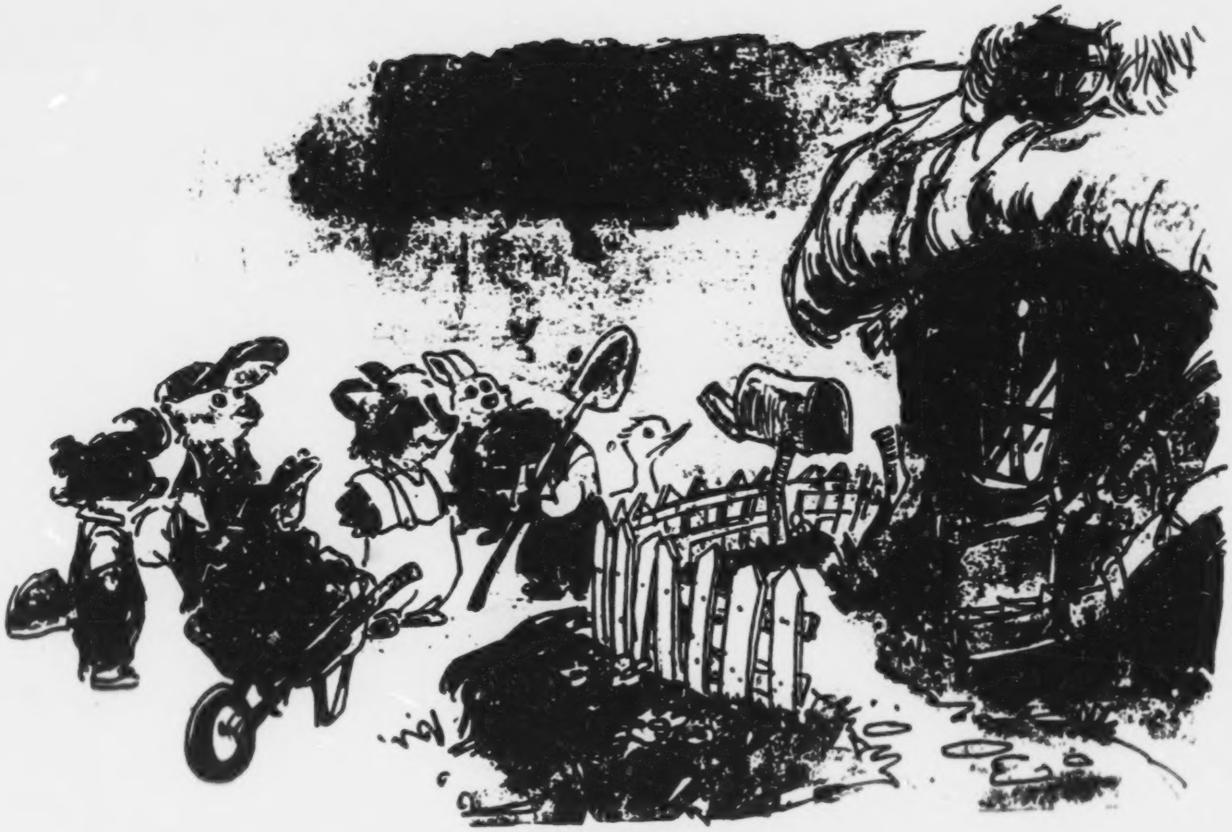

Warm and sunny — the perfect climate for adventure!

The Project

"What does Mr. Slaptail want us to do?" Riff called to his cousin, Rosie. They ran together toward her neighbor's house.

"I don't know," Rosie answered. "He just said to come over as soon as we could. He said he needs help with a project."

"Well, he asked the right kid! I'm Mr. Super-Project!" Riff said.



"Yeah, right — Mr. Mess is more like it! You've always got your pockets full of stuff for making things," Rosie added, grinning at her cousin. "Look, you've got a piece of string hanging out right now!"

Suddenly a loud, banging noise filled the air. "What in the world?!" said Rosie.

Rounding a corner on the sunny dirt road, the two cousins nearly bumped into a small group of their Bright Water Corners neighbors. They were standing in front of Mr. Slaptail's house. The noise seemed to come from the trees above his house.

"What's making all that racket?" Riff asked Freda Frog.

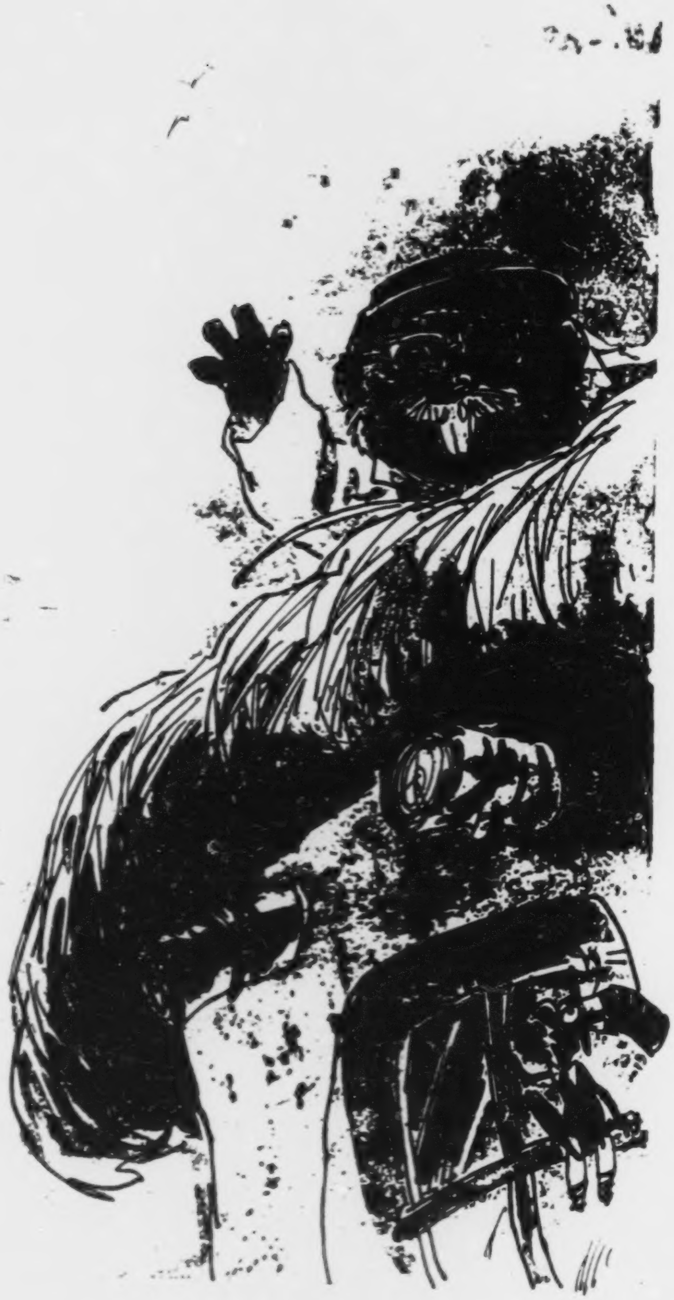
Freda chuckled, "You mean, *Who's* making all that racket, don't you? It's just Castor Slaptail, building some goofy contraption on his roof!"

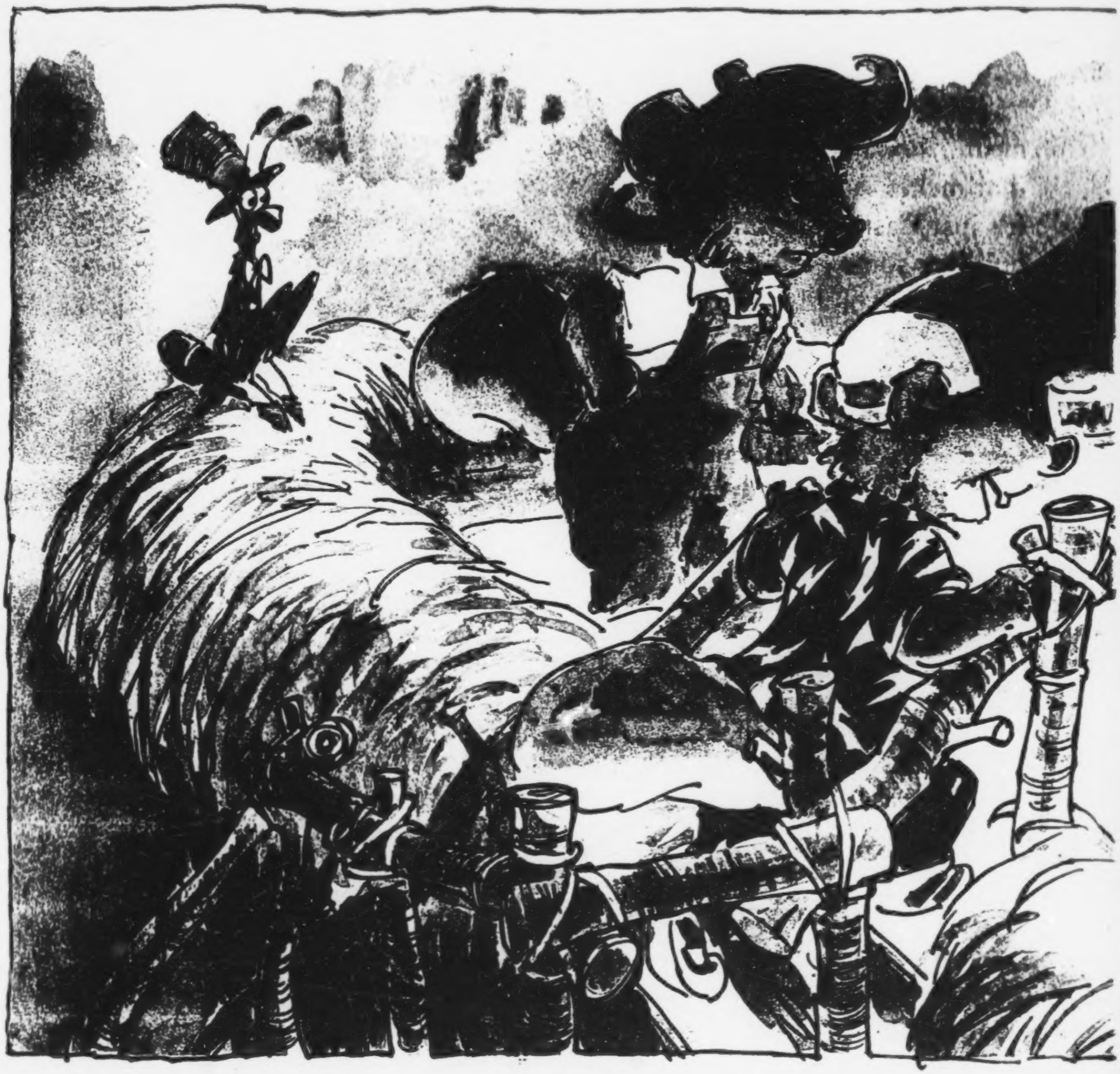
"We were on our way back from Beulah's coal mine with our fuel," said Ricardo Raccoon, "when we heard all that banging."

Wally Weasel added, "— and there was old Slaptail, crashing and bashing around up there! I think he's lost his mind for sure!" All the neighbors laughed.

The noise from above stopped. Mr. Slaptail's face appeared over the roof's edge.

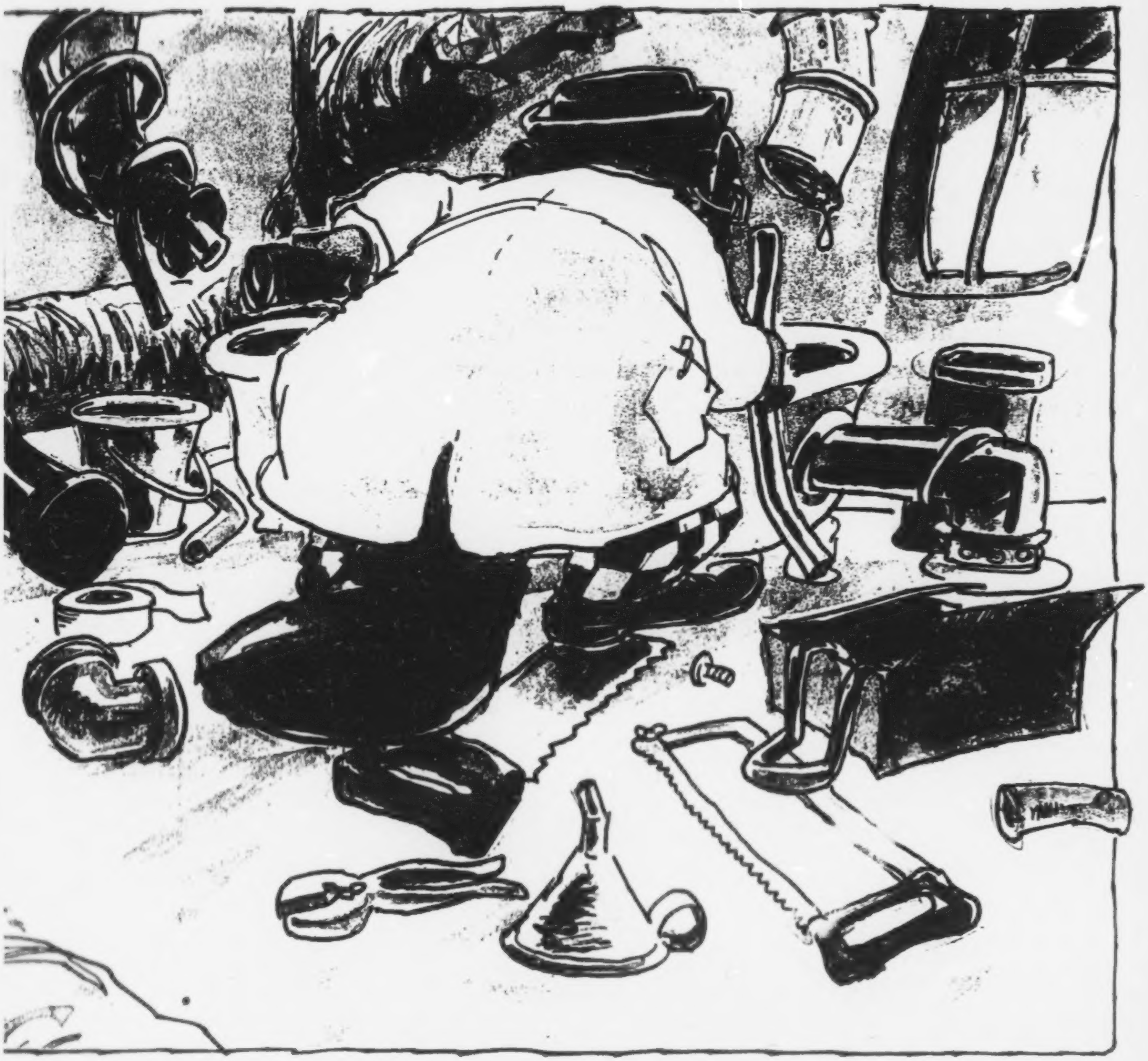
"You sound like a happy group," he said brightly. "Ah — Riff! Rosie! You're just in time to give me a hand. I want to get this done today. Come on up!"





Waving good-bye to the neighbors, the cousins skipped up the stairs to Mr. Slaptail's roof deck. There, they came face to face with . . . The Contraption. It looked like an old bathtub turning into a submarine. There were pipes and pieces of metal coming out of it everywhere.

"Hey, what are you building?" asked Riff. "It looks cool!"



Mr. Slaptail did not answer. He just went back to his work and said, "Help me with this pipe, will you? I'd like to get out of this sun and take a bath, using my new invention."

Rosie scratched her head. A bath? With that contraption? On the roof? Maybe the neighbors were right. What was their friend doing now?

Sun Power

"Mr. Slaptail," Rosie said, "what on earth *is* that thing, anyway?"

"You are looking at my new solar water heater!" he said. "You see, I'll turn on the water. The sun will heat the water in the pipes, and this black lid on the tub will help it stay warm. Then, when I'm ready for my bath, all I have to do is pull the chain, and — whoosh — hot water comes right into my bathtub."

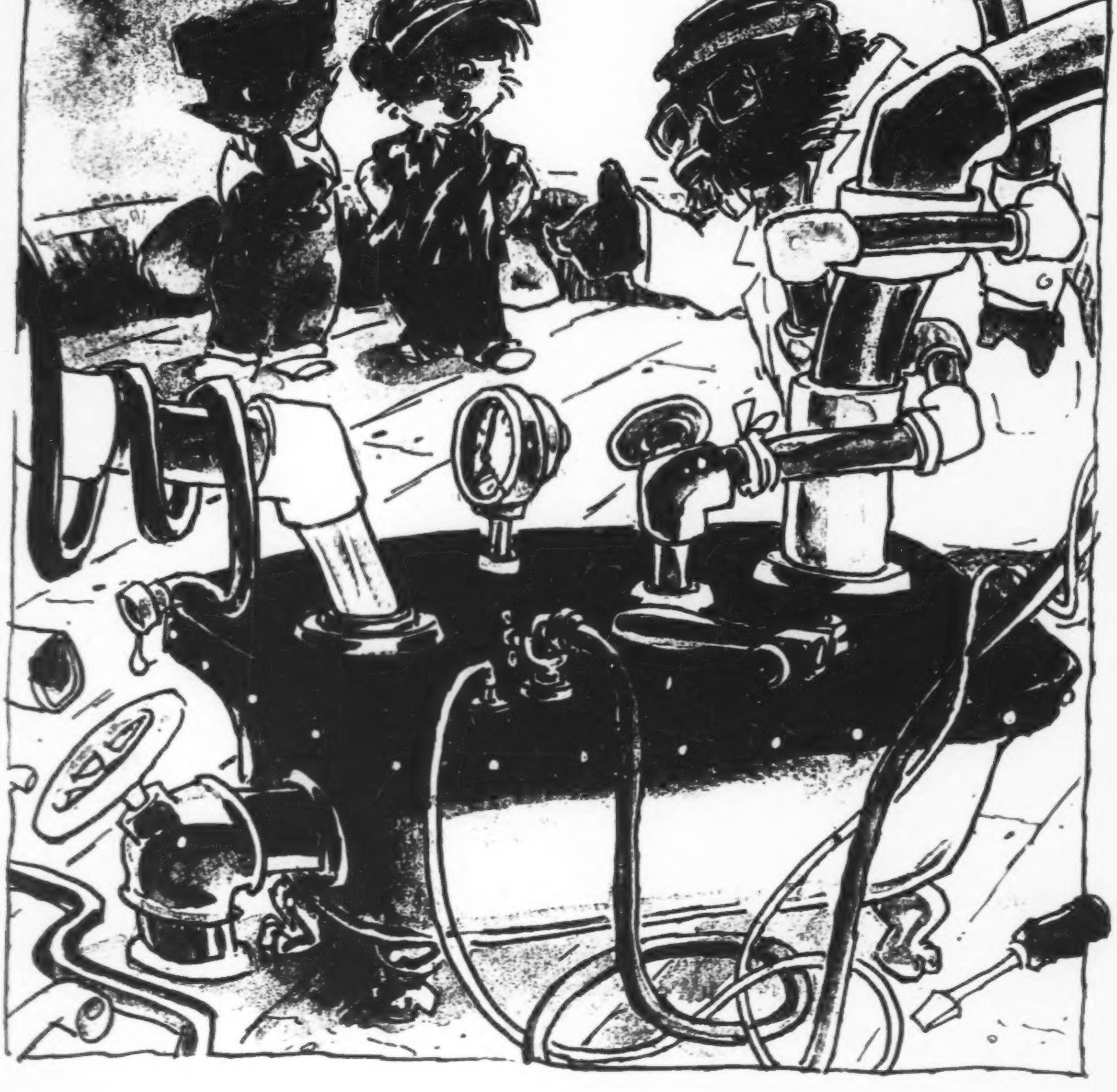
"How silly!" Rosie said. "Why do you want to take a bath on the roof?"

"Why not?! It sounds like fun!" said Riff. "You can see the trees and the clouds . . . ."

The sun gives us energy. Everything on Earth needs energy to move or grow. We can feel some of this energy as heat and see some of it as light.

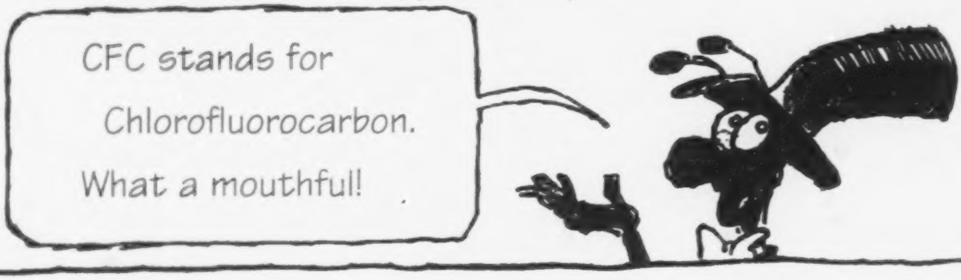
Energy from the sun causes weather. Heat from the sun keeps us warm. Wind and ocean currents are caused by the movements of air and water of different temperatures.

Light energy is used by green plants to make food. Plants combine carbon dioxide from air, water and nutrients from soil, and energy from the sun to make new leaves, stems, flowers and roots. All life on the planet depends on food and fuel made by plants.



In addition to light that we can see, the sun produces other wavelengths of light that we cannot see. Some of these, called ultraviolet light, can be harmful to living things. Ultraviolet light has more energy than ordinary light. It causes sunburn and can harm skin.

Most ultraviolet light never reaches Earth's surface because it is blocked in higher parts of the atmosphere. Some chemicals, known as CFCs, can damage the blocking layers of ozone in the upper atmosphere.


CFC stands for Chlorofluorocarbon. What a mouthful!

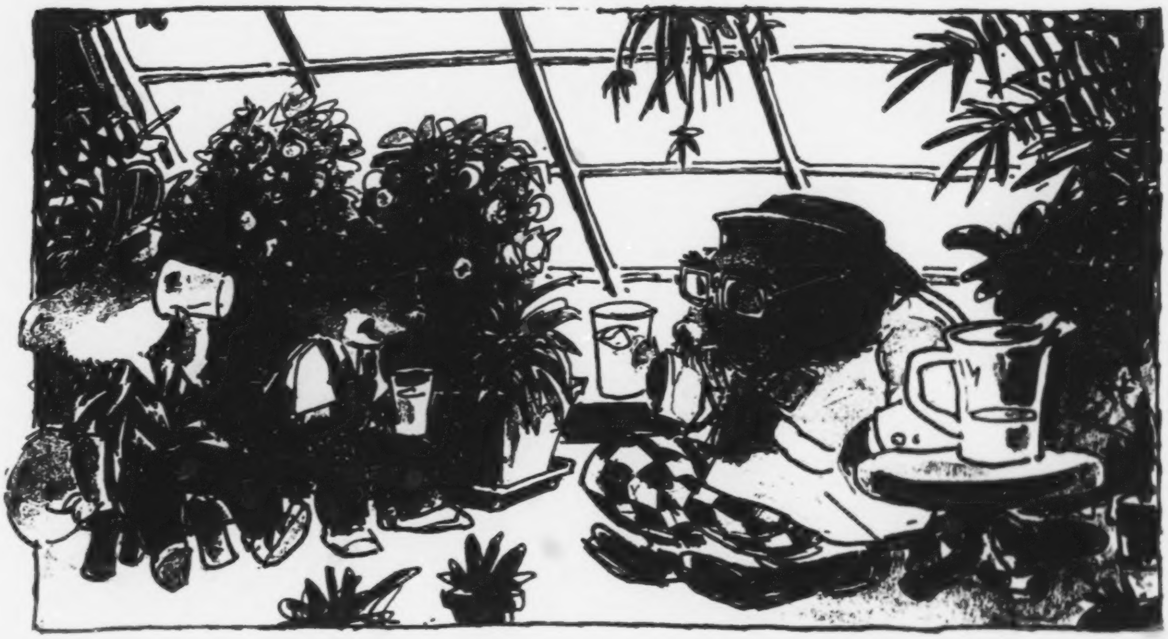
Mr. Slaptail laughed. "Take a bath on the roof?! Oh, no! *This* isn't my bathtub," he said, still chuckling to himself. "This contraption is my new invention — hot water directly from the sun! With my solar water heater, I won't have to have a fire to get hot water anymore," said Mr. Slaptail, "— but my *bathtub* is down in the house."

"Rats!" said Riff. "It would be great to take a bath up here!"

"The neighbors were right. I think you're *both* crazy!" Rosie said.

"Crazy?" Mr. Slaptail said. "Just wait 'til you see how it works! But right now, we all could use a cool drink. Let's get out of this sun for a while."

"Yeah, this is the worst time of day to be out in the sun," Riff said. They all headed down the stairs and into the house.



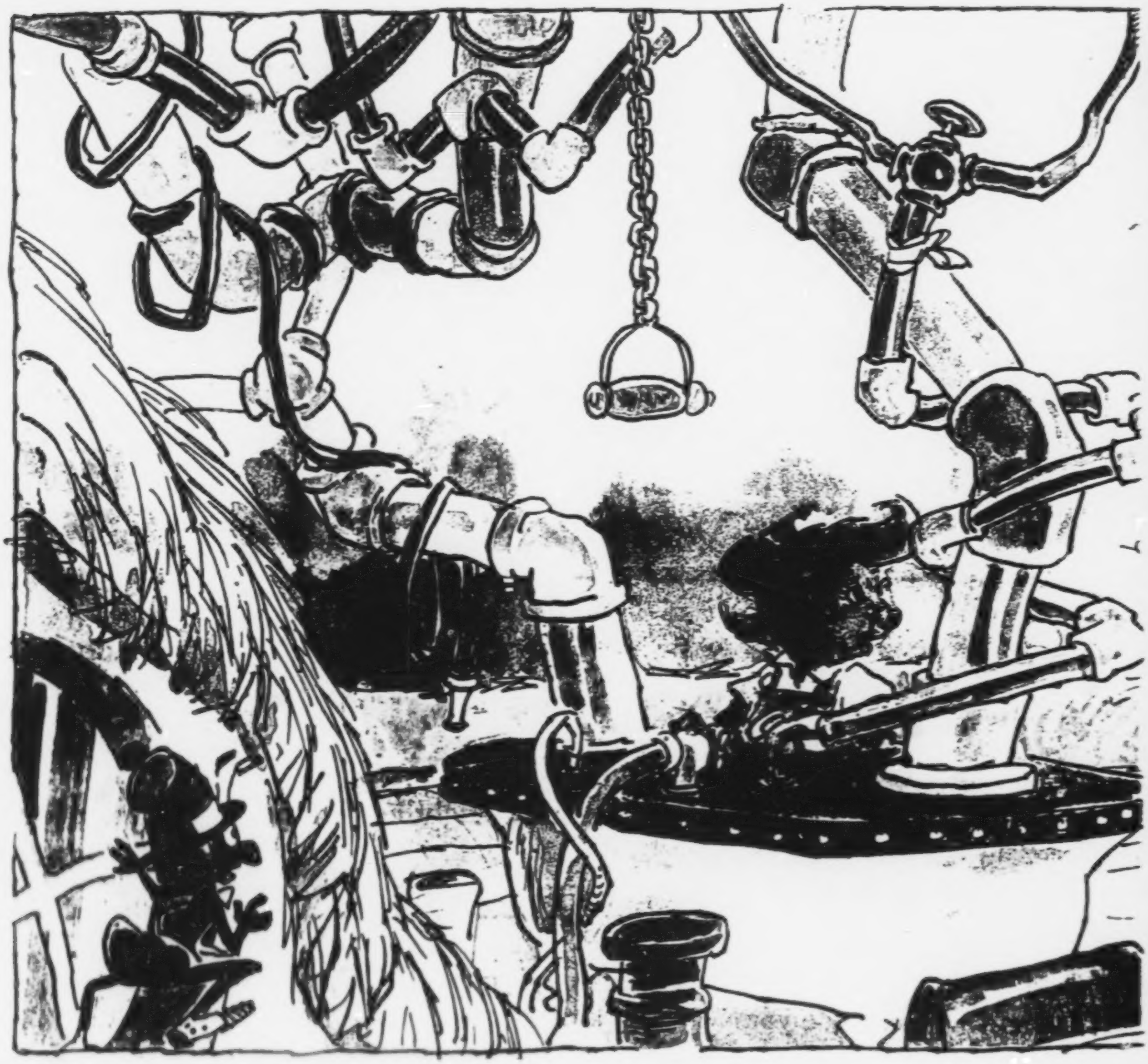
"Whew! Feel how warm it is where the sun comes in these windows," Rosie said.

"Yes, but it's great in our climate," Mr. Slaptail replied. "It's almost like having a greenhouse. I can grow lemons right here in the house during our cold winters."

"Wow! You mean you grew the lemons for this lemonade yourself?" Riff said.

"Right you are," Mr. Slaptail answered. "Now, drink up and let's get back to work. Once I get the drain pipe on, we can try it out!"

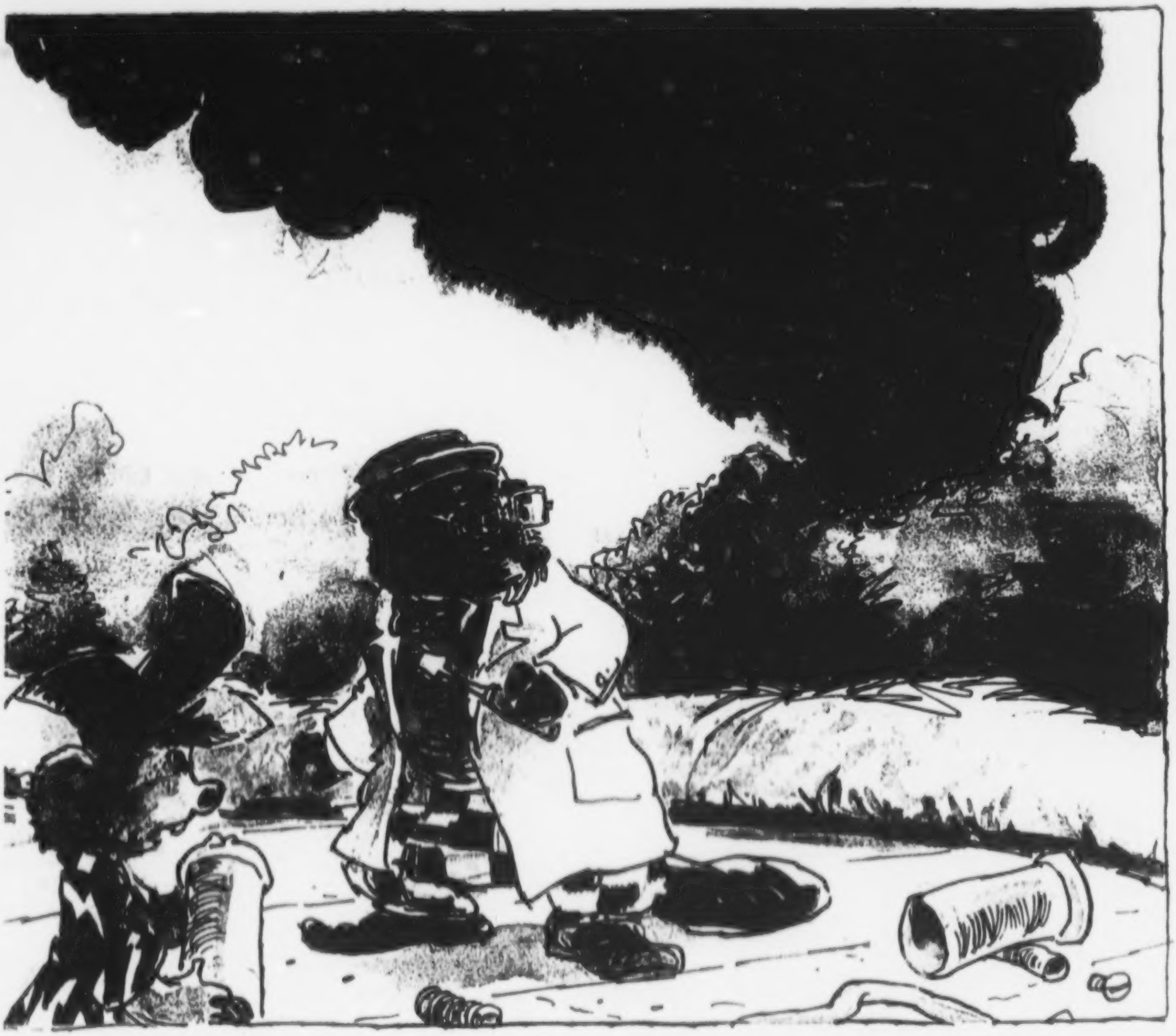
Sunlight comes through the windows and warms the air. The same thing happens on our planet. Some gases in the atmosphere help keep the Earth's surface warm, just like Mr. Slaptail's windows do in his house. Carbon dioxide is one of the heat-trapping gases.



KABOOM!

Riff finished his second glass of lemonade and followed Mr. Slaptail and Rosie back to the roof.

"We have to stick this end of the pipe into that hole. Rosie, you set it over the hole. I'll push and, Riff, you hold it right there," Mr. Slaptail explained.



They worked together for a few minutes, pushing and tugging until the pipe was in place. Mr. Slaptail tightened screws and turned on the water.

The job was done! They stood back to admire Mr. Slaptail's curious contraption, when — suddenly, there was a loud BOOM!

Their heads snapped up. Riff yelled, "Look at that smoke over there! There's a fire at the park — a big one!"

Wow! Did you know that burning is a chemical reaction?

When something like fossil fuels or wood burns, it uses oxygen. Carbon dioxide and water vapor usually are produced at the same time. When a fuel doesn't burn completely, it can make black smoke or soot.

"No, it's farther away than that," Rosie yelled. "And look at the smoke. It's as black as coal!"

"Coal . . . That must be it!" Mr. Slaptail said. "The mine must have exploded at Beulah Diggerpaw's coal yard and started a fire!"

Off to the Coal Mine

Mr. Slaptail hurried down the stairs again, followed by Rosie and Riff. "I've got to get over there!" Mr. Slaptail cried. "Got to see what happened — see if Beulah's all right . . . ."

They ran down the road toward the rising smoke. Soon they met Mr. Blackduck, pushing his wheelbarrow. "What do you suppose that smoke is?" he said. "Do you think it's the coal mine?"

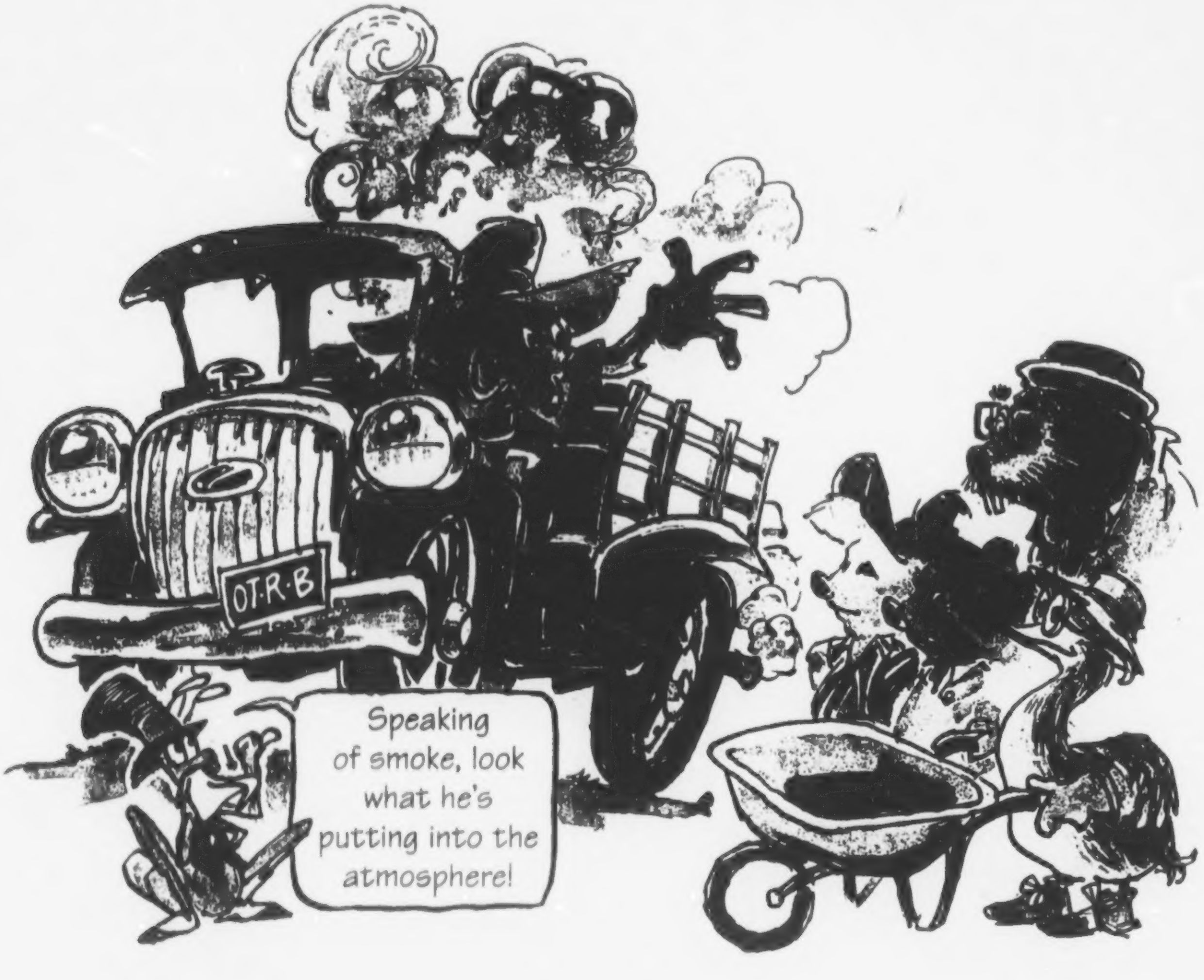
"I'm afraid so!" said Mr. Slaptail. "Come on — we have to hurry!"

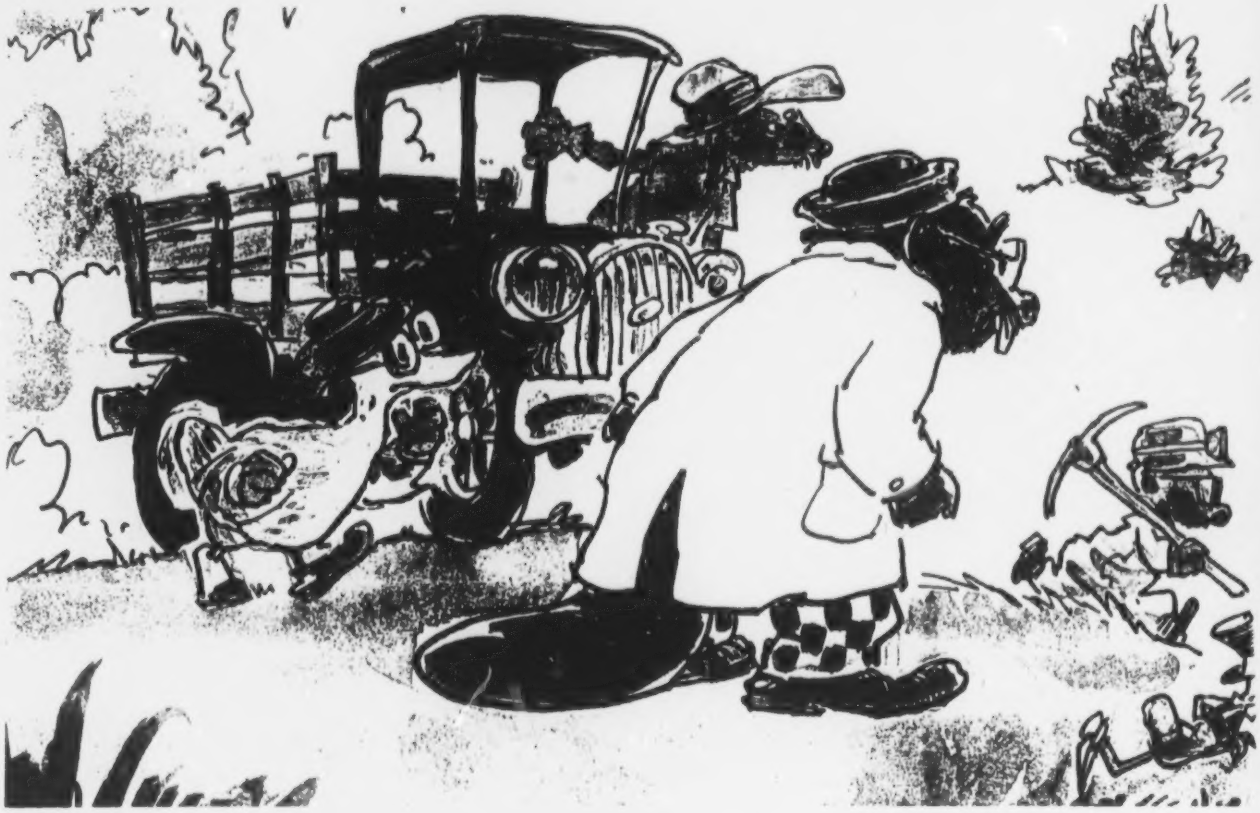
Riff and Rosie ran ahead. Mr. Slaptail and Mr. Blackduck puffed along behind them. All of a sudden, a loud horn startled them onto the side of the road.

"Hoo-hah! Slaptail! Where are you going in such a hurry?" said a voice from an old truck. It was their friend, Oscar Otterbee. He said, "Need a ride? I'm on my way to pick up some coal. All aboard for Beulah Diggerpaw's Coal Company!"

"Otterbee, look up! Don't you see all that black smoke in the sky?" Mr. Slaptail said. "There's a fire! We think it's at the mine. Come on, let's hurry!"

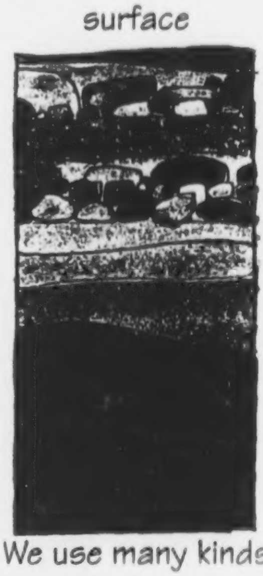
Mr. Slaptail, Mr. Blackduck, Rosie and Riff all leaped into the truck, and off they went. On the way they met other neighbors. They piled into the back of the truck, too.


OT-R-B
Speaking of smoke, look what he's putting into the atmosphere!



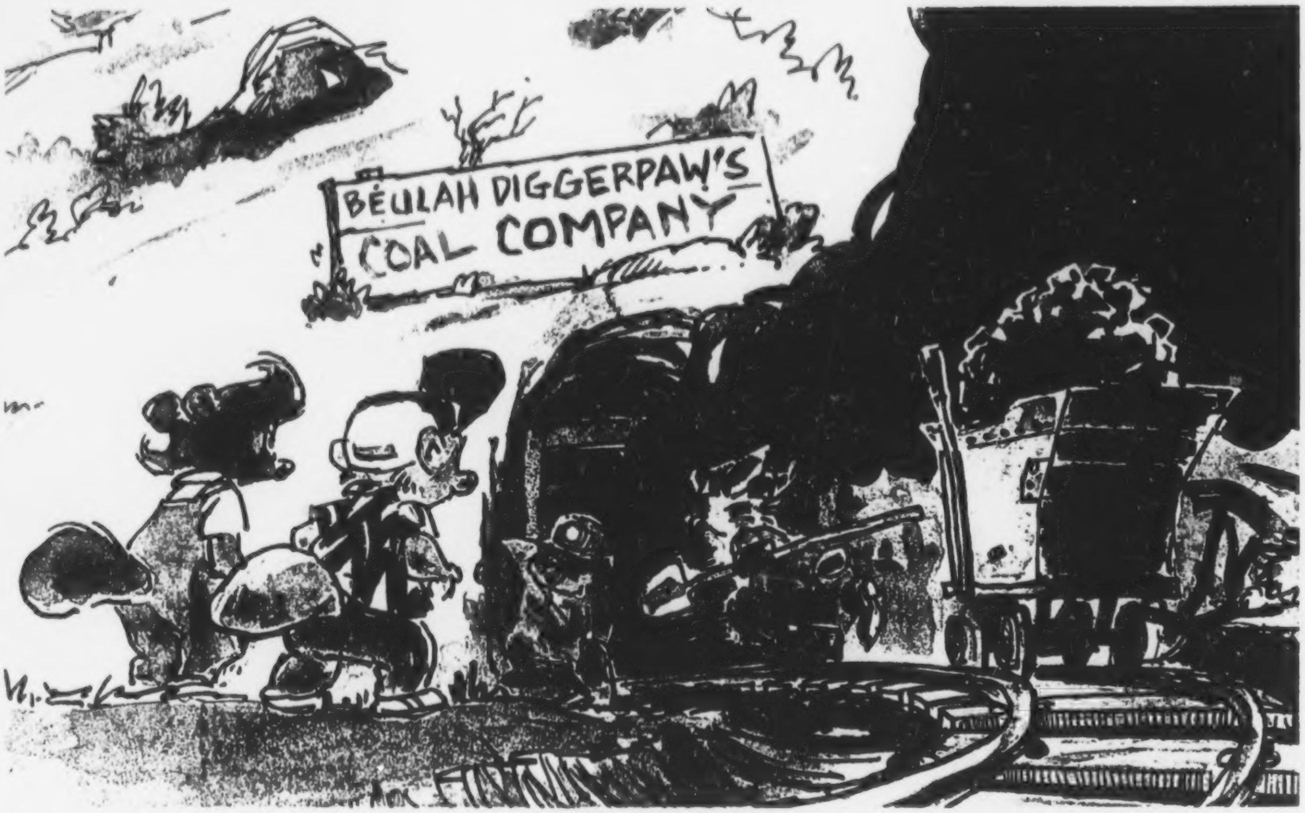
Soon they arrived at the yard in front of the coal mine. "That smoke is coming from the main entrance to the mine!" Rosie yelled.

"Yes, and the main shaft is blocked," shouted someone who was covered in black coal dust. "There was an explosion! Jake and I got out just before it caved in. Ms. Diggerpaw's still in there!"



A fuel is something that we can burn. Coal is a kind of fuel that is found underground. It is made from plants that died millions of years ago. We can burn coal to make heat to keep our houses warm. Coal is used to produce electricity.

We use many kinds of fuel in our cars and houses. Can you think of any other fuels?



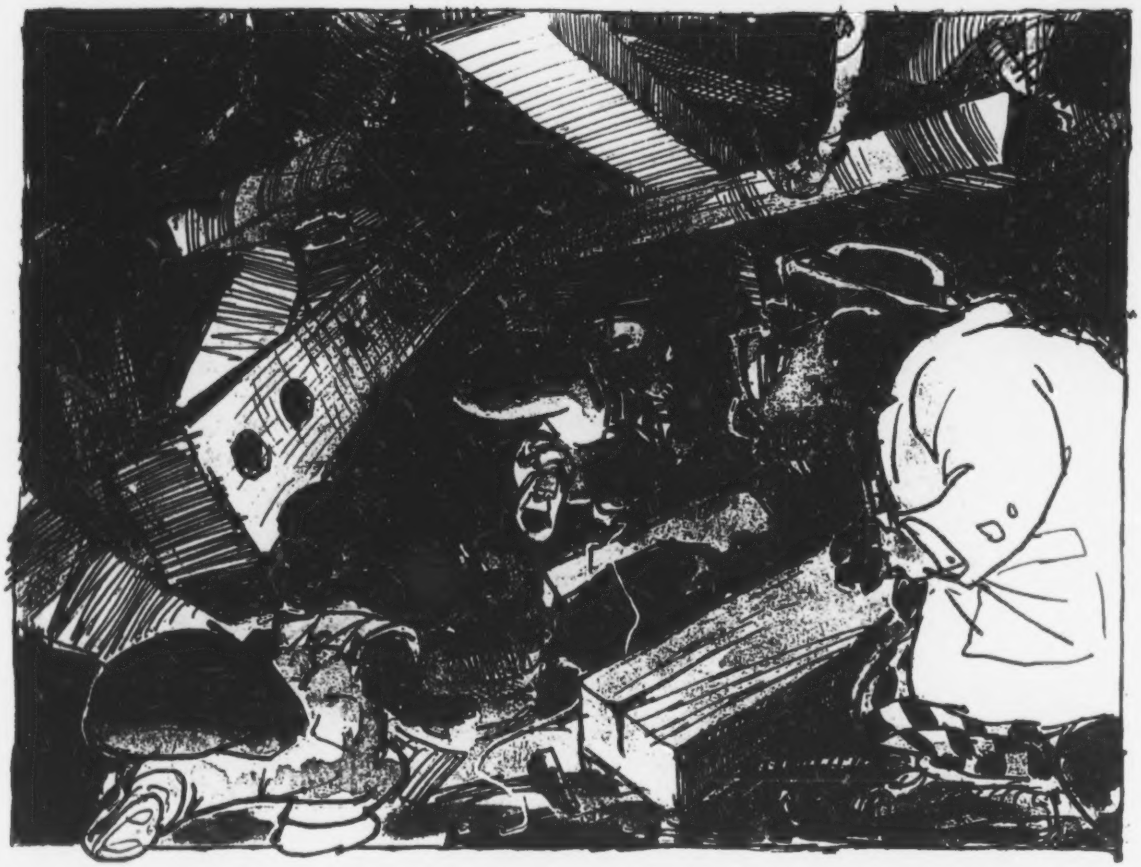
"Oh, no!" all the neighbors cried. "We've got to get her out! How can we get to her? What can we do?"

"There's an old entrance on the other side of the mine. It hasn't been used for years, but maybe we could get in that way," Mr. Slaptail said. He took off in a hurry. Rosie and Riff were right behind him.

"There it is — the old east shaft entrance," said Mr. Slaptail. "It's all boarded up! Let's try to get it open."

Riff tore off a piece of board. Soon they uncovered a small opening.

"Beulah . . ." Mr. Slaptail called. There was no answer — only a spooky silence. They all called Ms. Diggerpaw's name, but still there was no answer.



To the Rescue

"Help me with these boards," Mr. Slaptail said. "We need to make a bigger hole so I can get in."

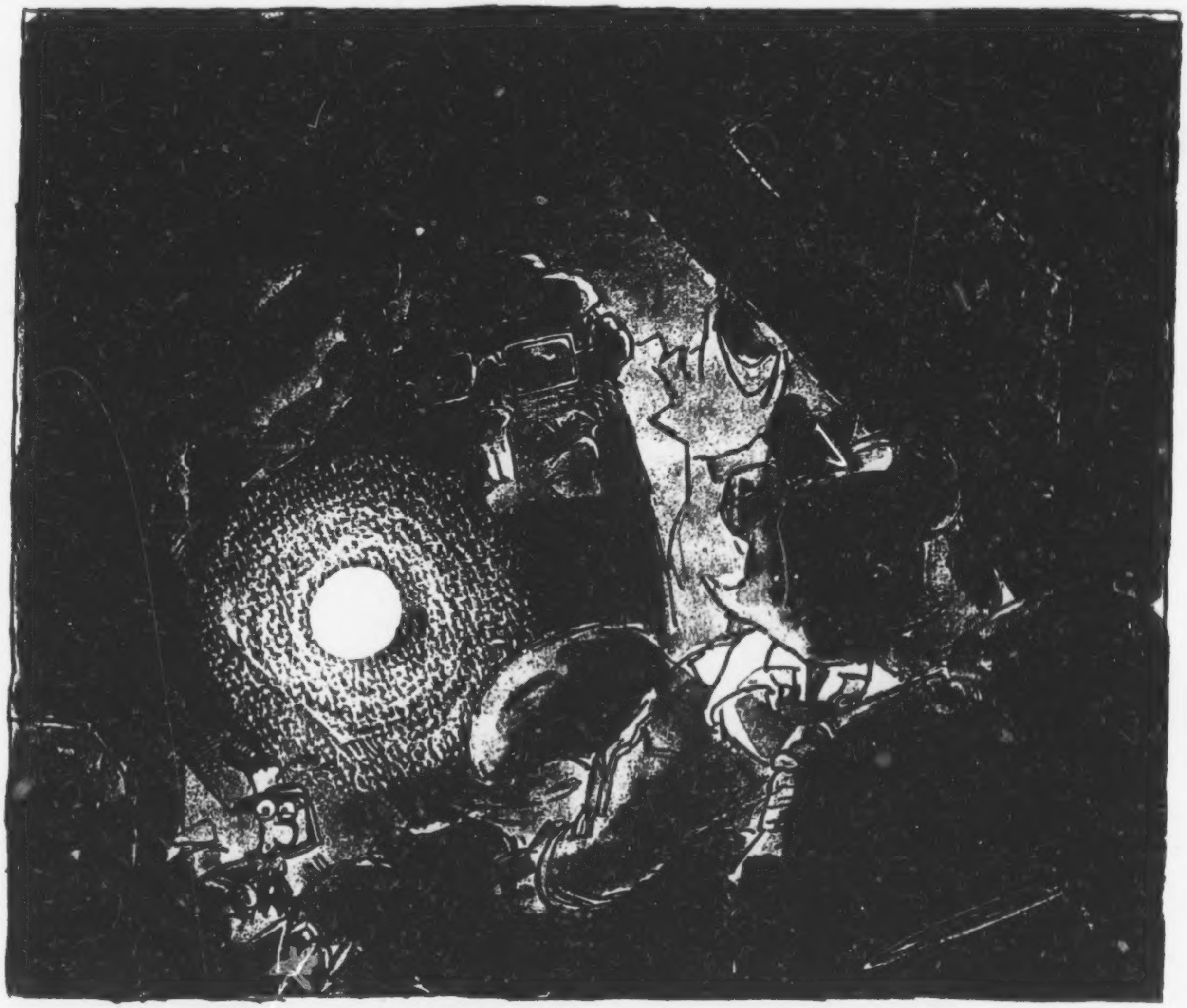
Riff grabbed a board next to the hole. Instead of pulling it, he jumped forward and squeezed into the tiny opening. Before they knew it, he was gone. Only the string coming out of his pocket could be seen, caught on a rusty nail.

"I'll go look for her!" Riff yelled back to his friends. They could barely hear his voice in the echoing tunnel — "Miiiiz Diggerpawww . . ." And then it was quiet.

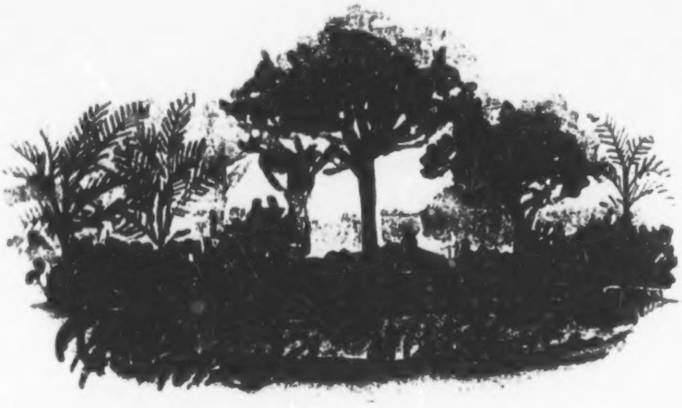
Rosie and Mr. Slaptail called, "Riff, come back. Don't go in there alone!"

It was too late. Riff was gone. They tried to move another board from the hole, but they couldn't get it loose.

Some neighbors finally joined them and, together, they cleared away the entrance to the tunnel. They all rushed inside.

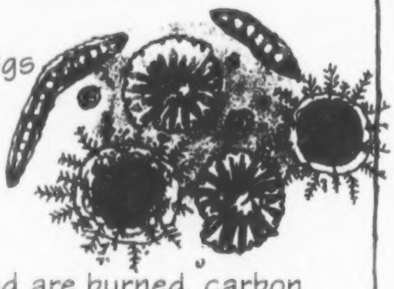


Almost all the fuels we use come from plants. Wood comes from the trunks and branches of trees. Oil, gas and coal come from plants that died millions of years ago. These fuels are called fossil fuels.



Coal comes from plants that became buried in swamps around 300 million years ago.

Oil and natural gas come from tiny living things that were buried on the ocean floor between 30 and 180 million years ago. The gasoline we use for cars is made from oil.



When fossil fuels or wood are burned, carbon that was trapped in plants a long, long time ago goes back again into the atmosphere as carbon dioxide. Some scientists think that this may lead to warmer temperatures on Earth.

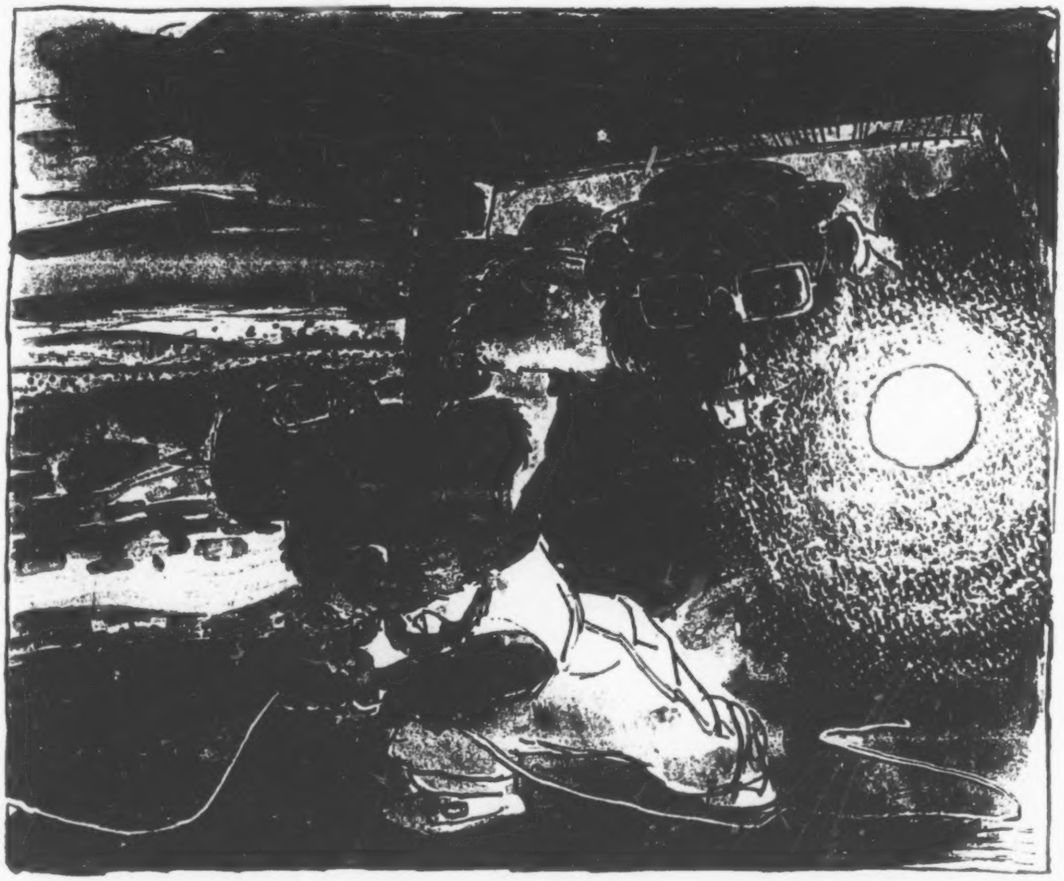
It's important for us to keep planting new plants, because they use carbon dioxide that's in the air.

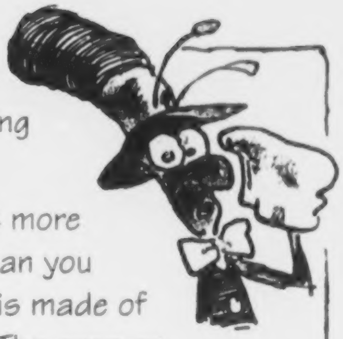
Mr. Slaptail's flashlight showed the path splitting in three different directions. Everyone stopped. "Which way did he go?" they asked each other.

"This way!" said Rosie. She picked up a piece of string, still attached to the nail back at the entrance. "This must be the ball of string in Riff's pocket!" she said.

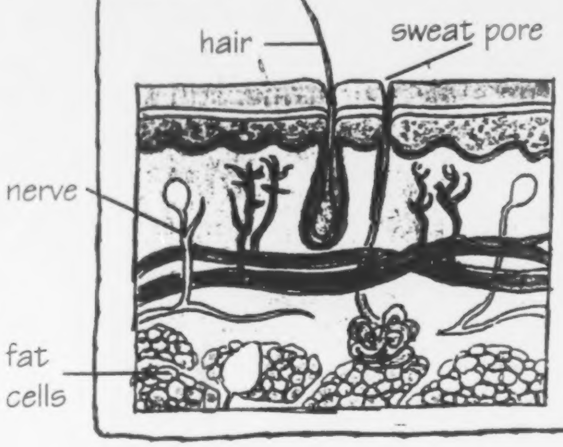
She led the others down the narrow path, following the string until it ended. With only a tiny light to show the way, the group inched forward.

"Rosie . . . Mr. Slaptail . . ." They heard Riff's voice at last. "Help . . . ," he hollered, "I found her!"



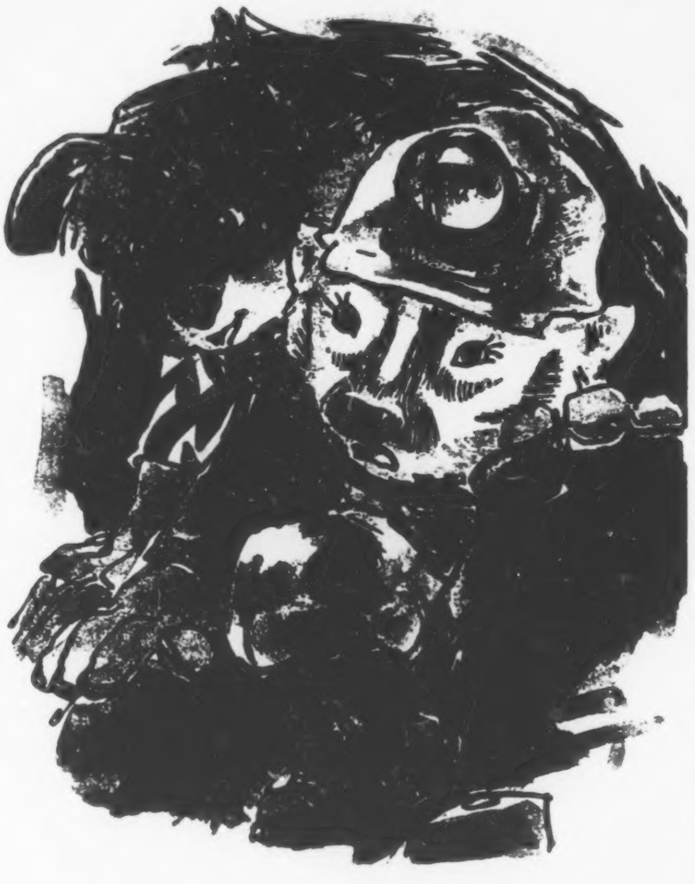


Look at all the dirt and soot on everyone! It's a good thing that skin keeps all that from getting inside our bodies.



Skin is a lot more complicated than you might think. It is made of layers of cells. The ones on top are dead. As dead cells fall off, new ones are made to replace them.

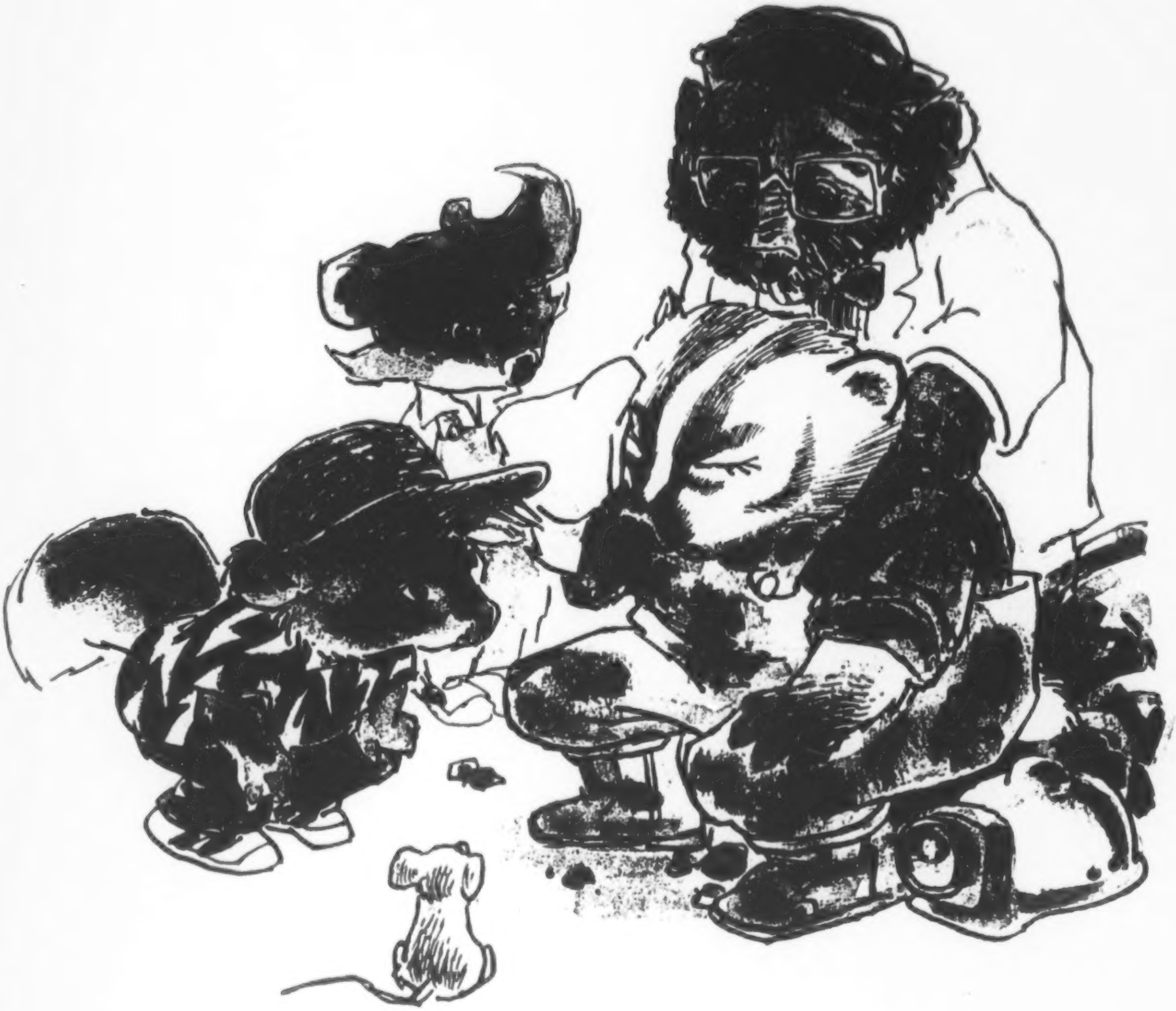
Don't forget to protect your skin — it's important!



Everyone rushed ahead until they found Riff helping Ms. Diggerpaw crawl through the tunnel toward them. They were covered with coal dust, and they both coughed as they crept along. No one spoke, but Mr. Slaptail and Mr. Otterbee quickly grabbed Ms. Diggerpaw and carried her out of the dark tunnel.

"Riff, are you all right?" Rosie asked anxiously.

"I'm okay," he replied, "but let's just get out of here, quick!" Rosie took Riff by the hand, as they joined the others leaving the mine shaft.

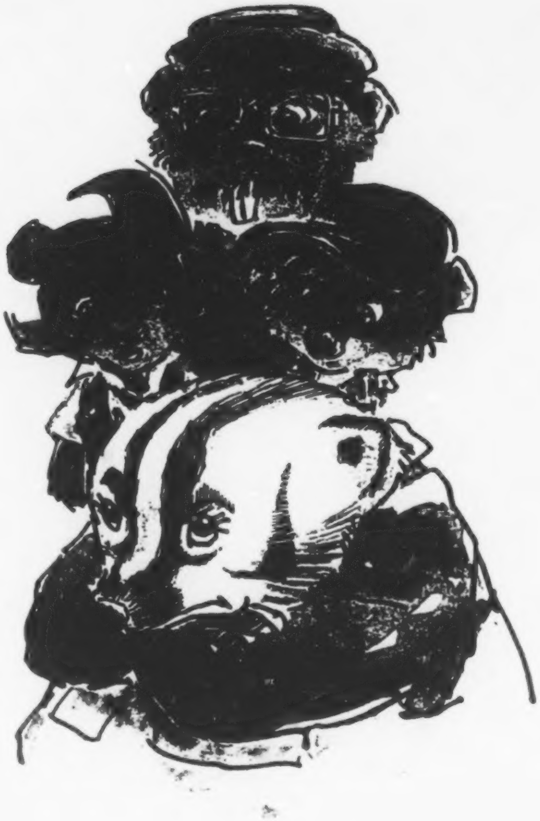


Ms. Diggerpaw's Decision

Beulah Diggerpaw sat on the ground, coughing and brushing off coal dust. Everyone circled around her.

"Thank goodness, you're all right!" Mr. Slaptail said. He gave her his handkerchief to wipe her face.

"I'm okay, I think," Ms. Diggerpaw sputtered, "— but I'm not going back into that mine, ever again!"



"What?!" said Mr. Slaptail. "What do you mean?"

"I mean I'm going to shut down the mine," Beulah said sadly.

All the neighbors looked at each other. "But what will we do for fuel?" they said. "We have to have coal for heat and for cooking!"

"Even the electric plant runs on coal," said Mr. Otterbee. "You can't shut down the mine!"

"Yes, I can — and I will! I'm not going in again! It's all caved in, and it's too dangerous!" Ms. Diggerpaw said. "Anyway, almost all the coal in the mine is used up. I would have *had* to close down before long."

Rosie's Idea

"But Bright Water Corners has to have fuel!" Mr. Blackduck insisted. "Where will we get it?"

"We'll just have to go over to Carbon Mountain. They have plenty of coal," said Ms. Diggerpaw.

"Oh, no — that's much too far! Oh, what will we do?" all the neighbors cried.

"We could use wood again," Mrs. Pondslider suggested.

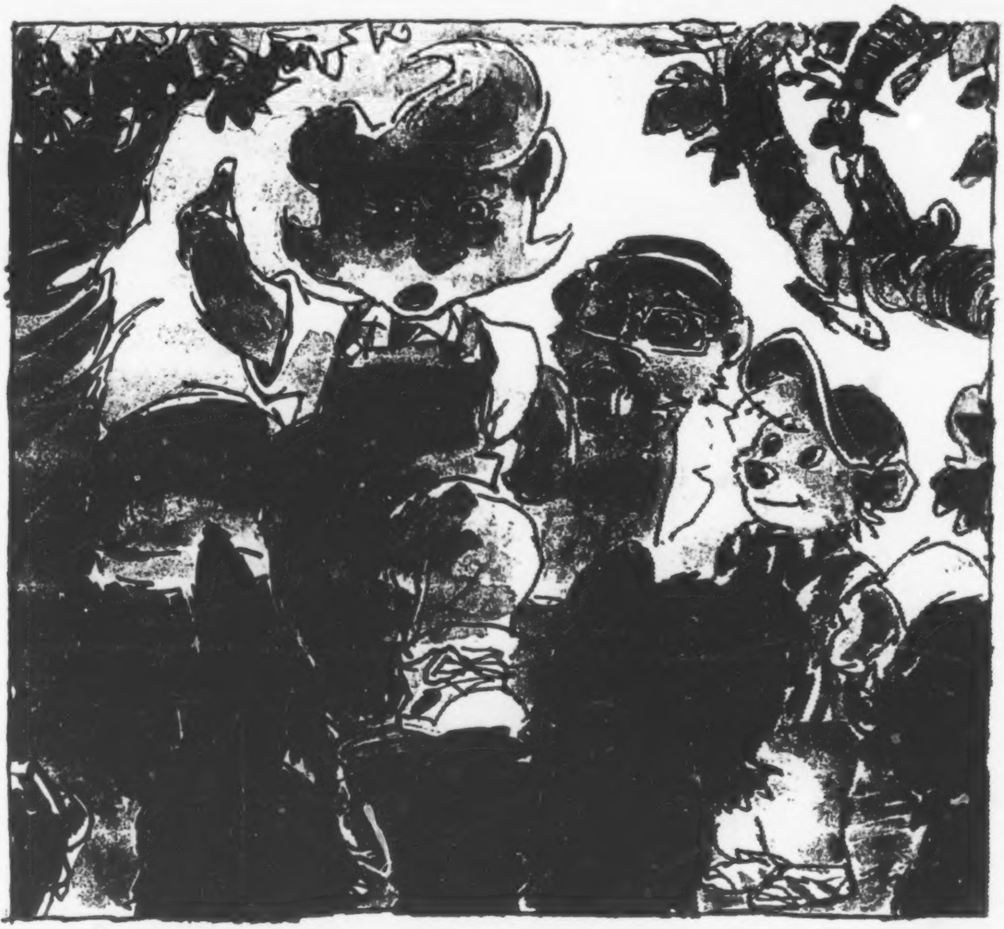
80

"Yes, but we don't want to do that," Mr. Otterbee said. "We need to *keep* our trees."

"Oh, my, yes! What would we do for food and shelter without our forest?" Dolores Deer agreed.

Rosie jumped up on a tree stump and said, "Wait! Maybe there's another way." Everyone stopped talking and looked at her.

"Mr. Slaptail invented a solar heater to use instead of burning coal to heat his water. Why couldn't *everybody* use power from the sun?" Rosie said.



"Solar heater?!" the neighbors cried. "*What* is that? What crazy thing are you doing now, Slaptail? You don't really think it will work, do you? That's nonsense," they said.

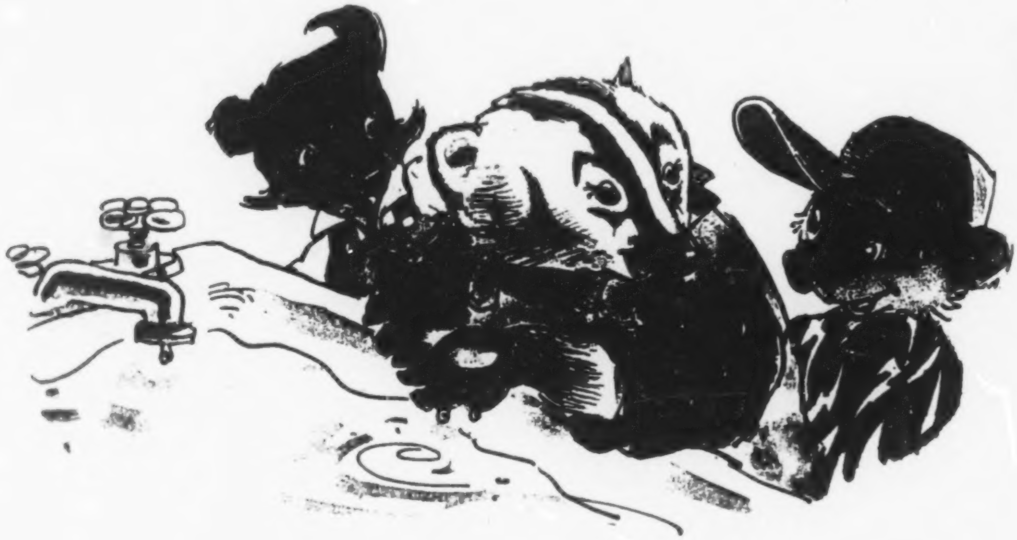
"No, it isn't," Riff said. "It's really going to work! It's making hot water for Mr. Slaptail's bath right now."

"Come on! We'll show you," Rosie added.

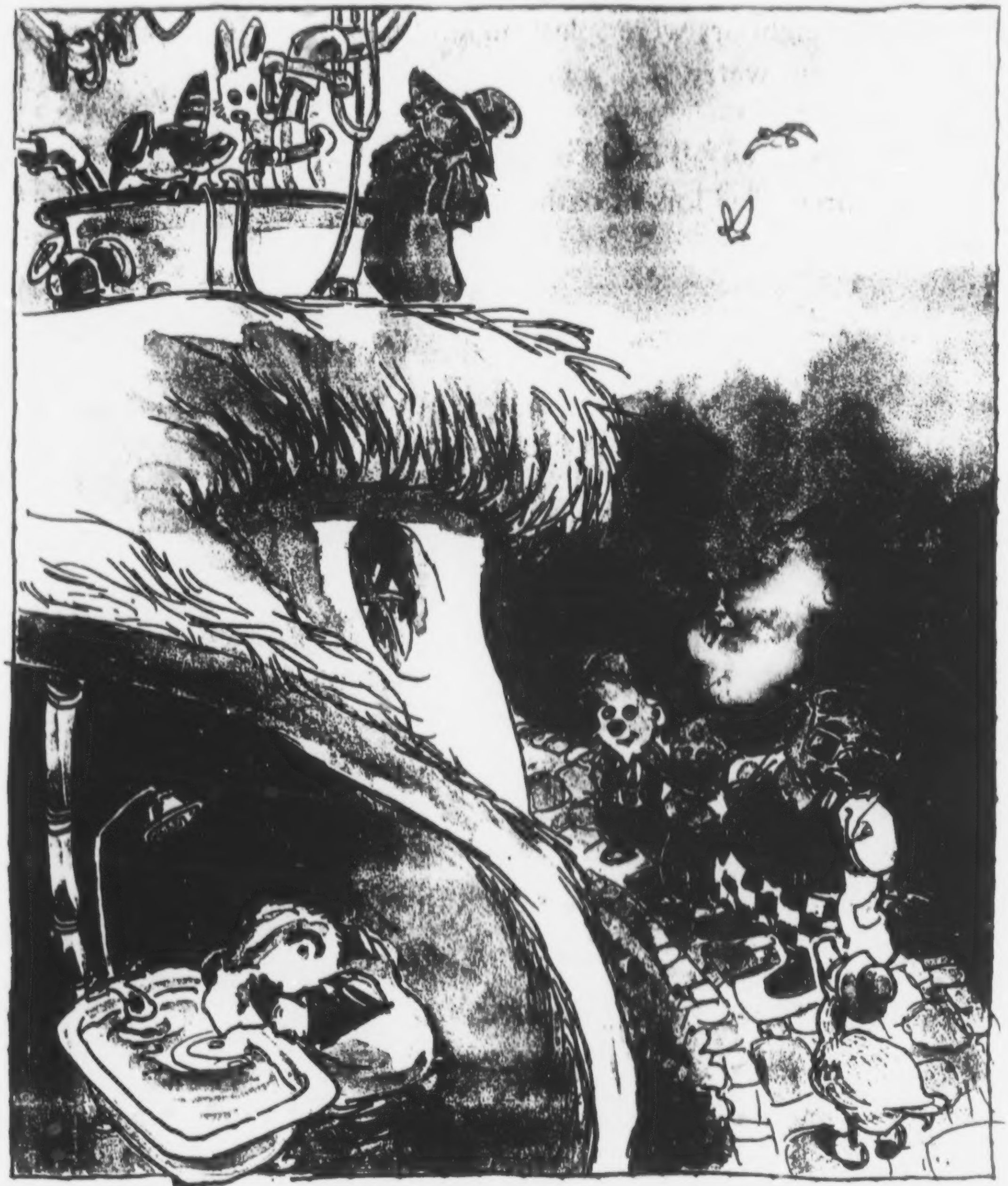
"Beulah, come over to my house. Let's get you cleaned up!" Mr. Slaptail said, and he helped Ms. Diggerpaw into the truck. Others piled in too, mumbling all the way about Mr. Slaptail's crazy ideas.

Only the Beginning

"Ooh, this feels good!" Ms. Diggerpaw said, as she splashed her face and arms with water from the bathtub in Mr. Slaptail's house. "Rosie's right — the water is nice and warm. You say the water heater is on the roof?"



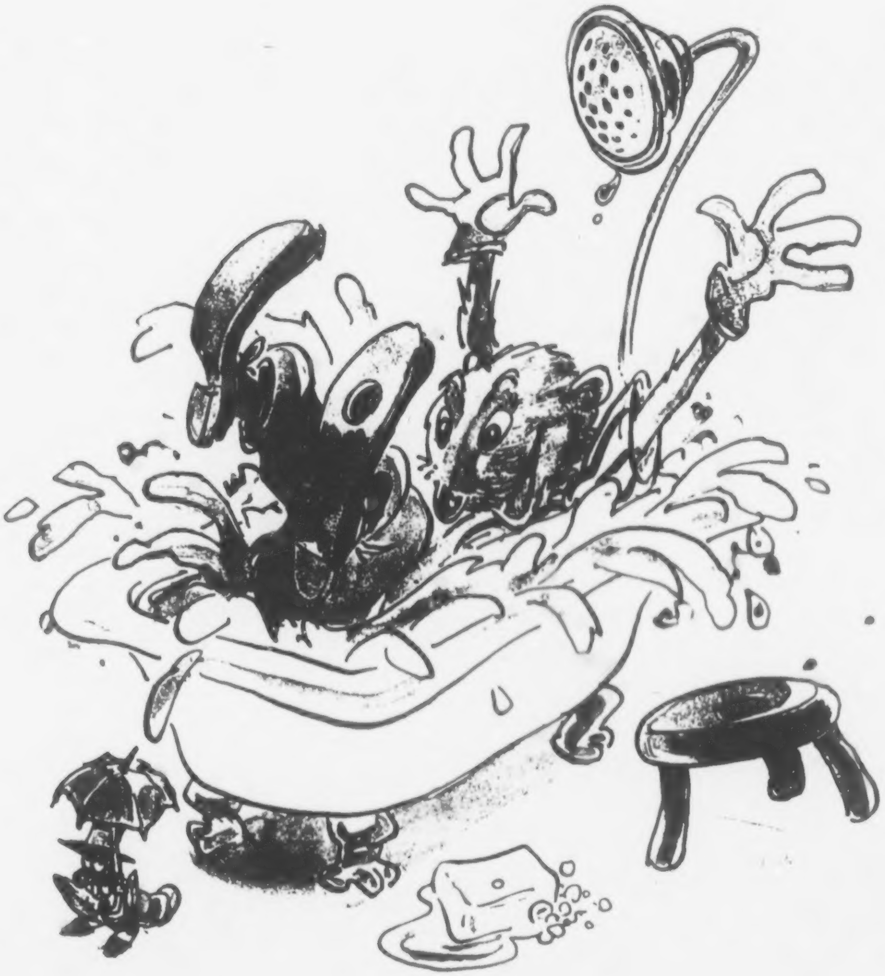
Mr. Slaptail took his friends outside to see his new solar-powered water heater. One by one, they climbed up the steps to look it over. They left a trail of messy, black fingerprints along the way.



When they came back inside, Mr. Otterbee said, "Move over, Ms. Diggerpaw. Let me see what that water feels like. Hoo-hah . . ." He jumped right in!

Soon all the neighbors were splashing and cleaning their sooty faces in Mr. Slaptail's warm water.

"Do you suppose we all could use this solar power?" Mrs. Pondslider said. "My children need lots of baths."



"It's all very well to have hot water," said Ricardo Raccoon, "but what about cooking and heat — and power for electricity?"

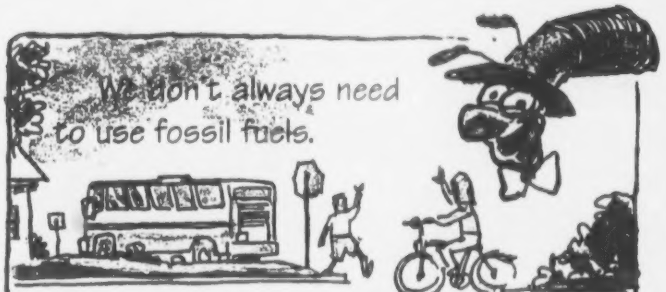
"My solar water heater is only the beginning," Mr. Slaptail answered. "There are lots of other ways to get energy for all those things!"

"How about using the wind, like my Grandpa used to do with his windmill?" said Mr. Blackduck.

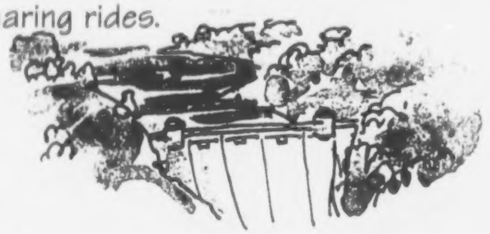
"And how about using the water wheel by the old mill again?" Rosie added.

Sully Salamander said, "If more folks would ride bikes instead of in cars, we wouldn't *use* as much energy."

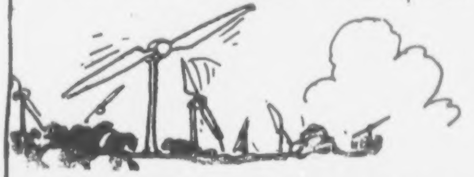
Everyone seemed to have an idea. "Wow!" Riff said. "You won't even *need* coal. Bright Water Corners is going to be super-energy city!"


We don't always need to use fossil fuels.

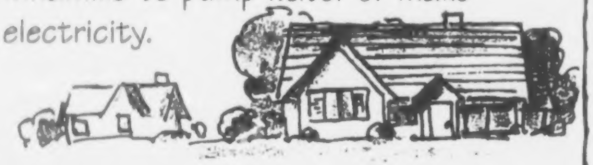
We can save fuels by riding a bicycle, walking, taking a bus or sharing rides.



We can use the power of water to make electricity. We can trap energy from the sun like Mr. Slaptail did.

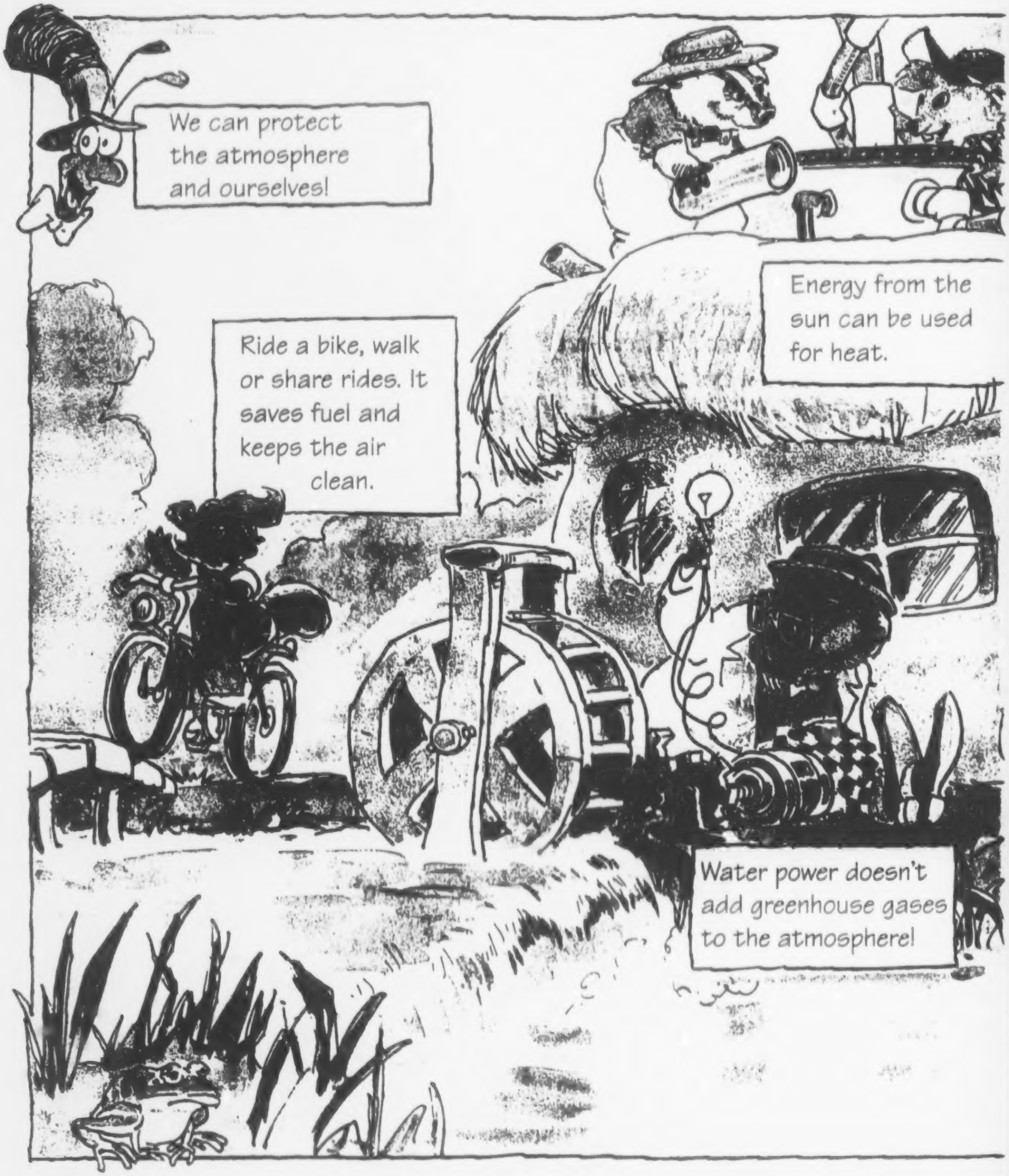


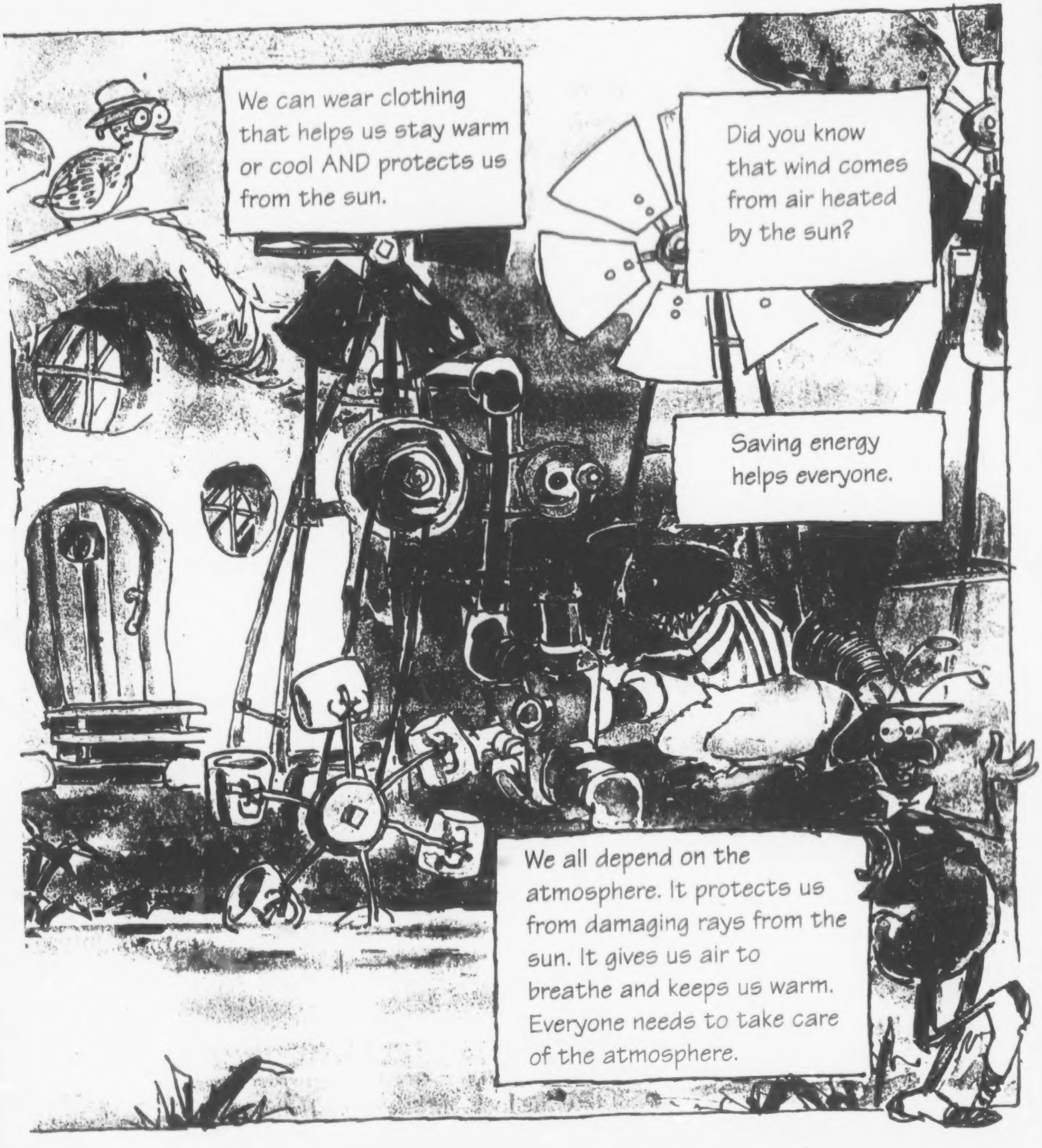
We can use the wind to turn windmills to pump water or make electricity.



We can build houses that are easy to heat and cool.

Even though we usually use them for burning, fossil fuels have many important uses. Did you know that plastics, asphalt for roads and some medicines come from fossil fuels?


We can protect the atmosphere and ourselves!
Energy from the sun can be used for heat.
Ride a bike, walk or share rides. It saves fuel and keeps the air clean.
Water power doesn't add greenhouse gases to the atmosphere!

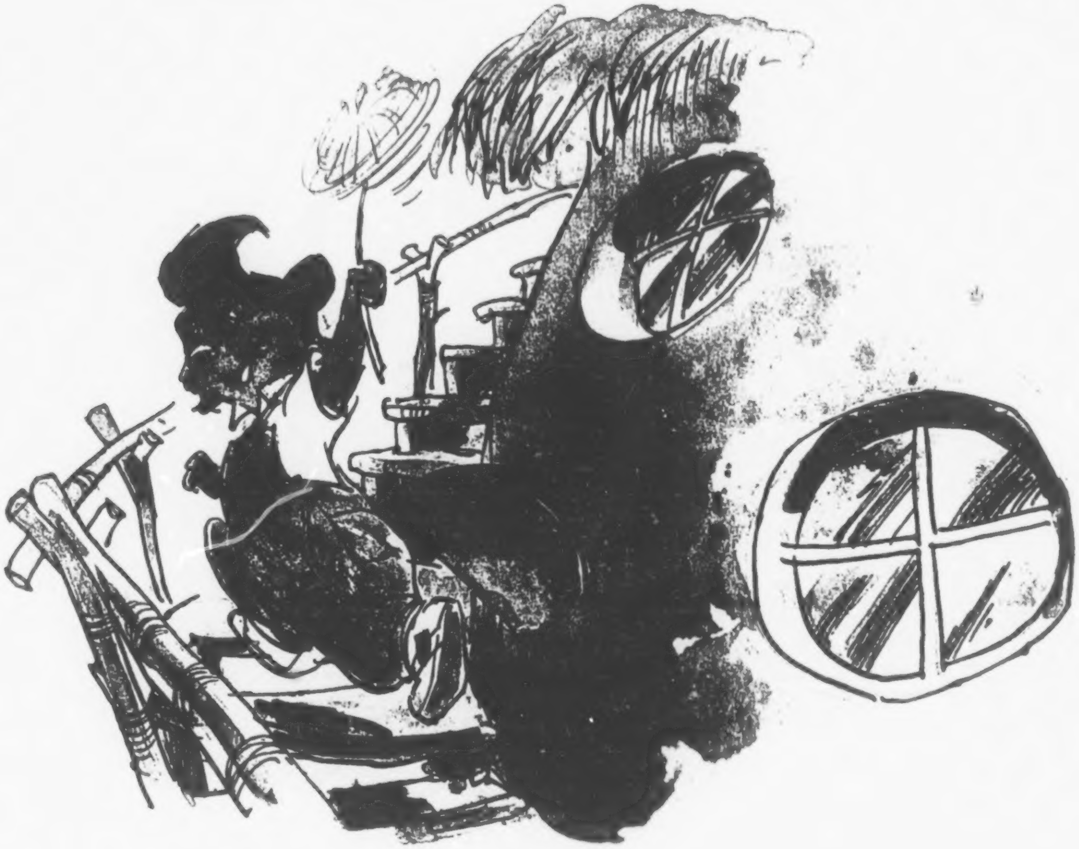


We can wear clothing that helps us stay warm or cool AND protects us from the sun.

Did you know that wind comes from air heated by the sun?

Saving energy helps everyone.

We all depend on the atmosphere. It protects us from damaging rays from the sun. It gives us air to breathe and keeps us warm. Everyone needs to take care of the atmosphere.



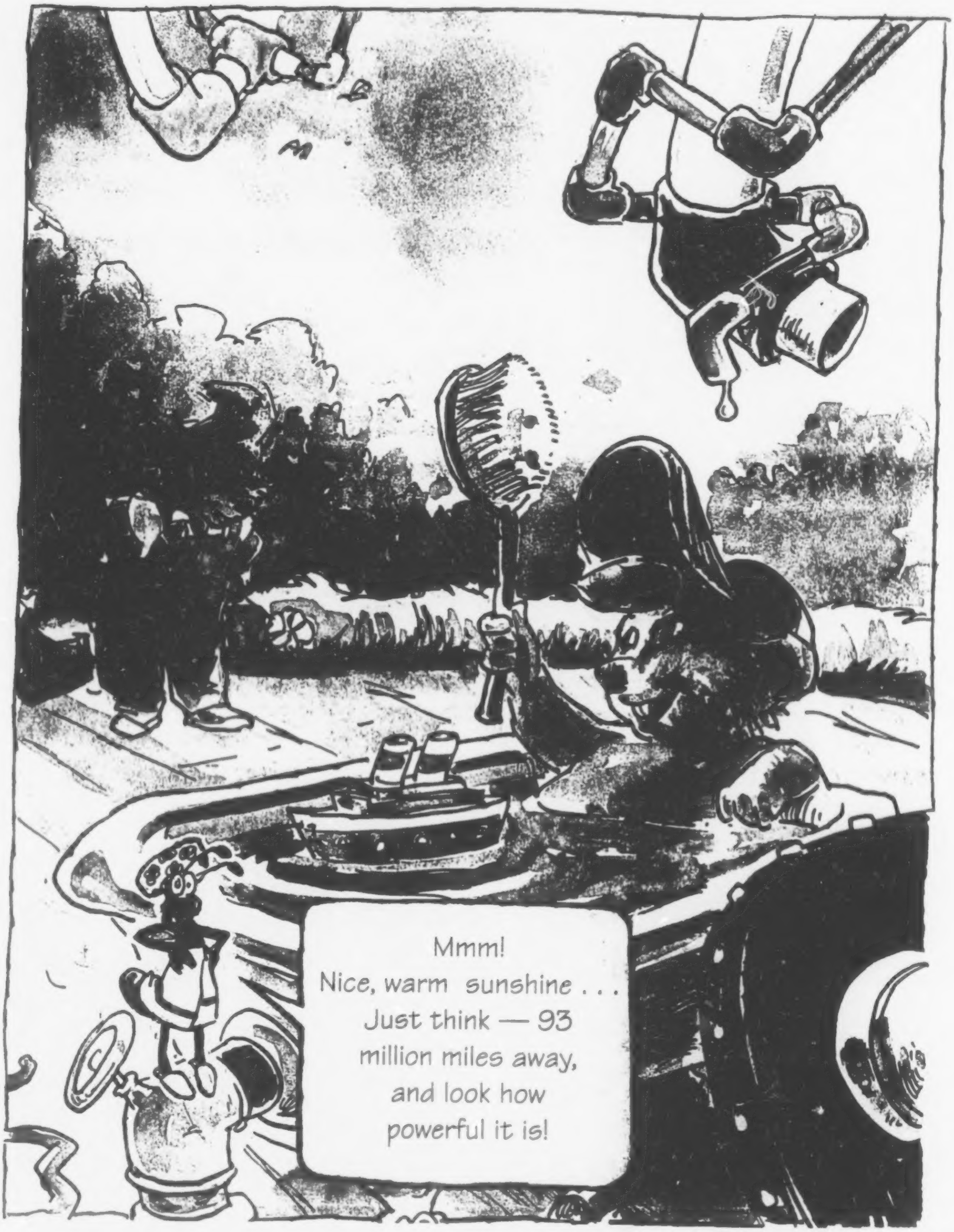
Up on the Roof

"Riff, are you up there? Look at the pinwheel I made!" Rosie called. "It works just like the new windmill!"

Climbing up the steps to Mr. Slaptail's roof, Rosie held her pinwheel up in the air. The breeze made it spin so fast she could only see a blur.

Then she saw her cousin. "Riff, what are you doing?!" she said.

"Don't tell Mr. Slaptail, but *I* still like the idea of taking *my* bath on the roof!" said Riff, looking up at the trees and the clear blue sky.

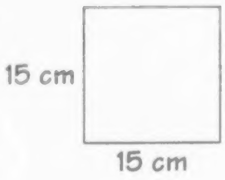

Mmm!
Nice, warm sunshine . . .
Just think — 93 million miles away, and look how powerful it is!

How To Make A Pinwheel

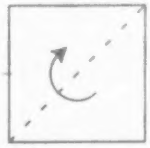
Materials: square of paper (about 10 to 15 cm); pencil with full eraser; ruler; scissors; straight pin

Procedure:

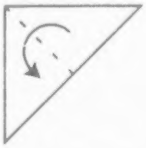
1. Start with a square piece of paper.



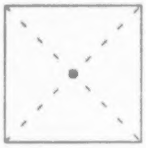
2. Fold the square in half to make a triangle.



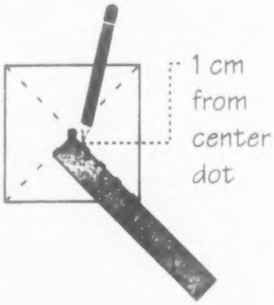
3. Fold the triangle in half, making a smaller triangle.



4. Now, unfold the paper. With your pencil, put a dot in the middle where the four fold lines meet.



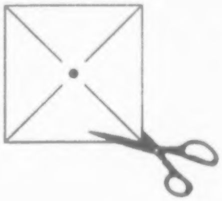
5. Lay your ruler from the dot along one of the folds to the corner.



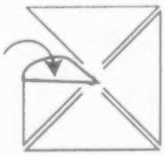
Starting 1 cm away from the dot, draw a line from there to the end of the point at the corner.

6. In the same way, draw a line to each of the other three corners, starting 1 cm from the center.

7. Cut on the lines you have drawn, from each corner to where the line stops 1 cm before the center.



8. Fold every *other* point in toward the center, over the center dot, so that the point reaches a little beyond the dot.



9. With four points folded down over the center, push a straight pin through them at the center of the wheel. Push the pin into the side of the eraser on your pencil.

10. Smooth out the creased edges a little, to open and puff out your wheel.

You have made a pinwheel! Wave it in the air or blow on it to make it go around.

I wonder??? What kind of power makes this wheel go around? What real-life machines work the same way?

90

Glossary

asphalt *(AS-falt)* — Blacktop; a black, gooey substance used for roofs and for paving roads and school-yards. The materials needed to make asphalt come from coal or oil.

atmosphere *(AT-muh-sfeer)* — The thin layer of air that surrounds the Earth.

carbon *(KAHR-buhn)* — An element found in all living things, and also in coal, charcoal and oil. Carbon is in some gases, like carbon dioxide.

carbon dioxide *(KAHR-buhn dy-AHK-syd)* — A gas made up of carbon and oxygen. You cannot see or smell it. It is given off when living things breathe and when things burn or decay. It is used by plants to make food.

cell *(SEL)* — The smallest unit of all living things.

CFC (stands for **chlorofluorocarbon**) *(KLOR-oh-FLOR-oh-KAHR-buhn)* — Chemicals (containing carbon, chlorine and fluorine) used in refrigerators, some aerosol spray cans and foam plastics. When released into the atmosphere, CFCs slowly rise upward and eventually damage layers of ozone that block dangerous radiation from the sun.

chemical reaction *(KEM-ih-kuhl ree-AK-shun)* — When two or more materials combine to create new products.

climate *(KLY-mit)* — The kind of weather a place usually has.

coal *(KOHL)* — A natural, black, solid substance that is formed from partially decayed plant matter buried in swamps long ago. Coal consists mainly of carbon, and often is used as fuel.

current *(KUR-uhnt)* — A flow of water, air or electricity that goes more or less in a definite direction, as a **wind current** or an **ocean current.**

electricity *(ee-lehk-TRIHS-uh-tee)* — A kind of power that can be used to produce light, heat and motion. Electricity used in homes and schools is made by generators that change water power or heat from burning fuels into energy that travels along wires.

energy *(EHN-uhr-jee)* — Power that can be used to move or lift something, or to make something warmer or cooler.

fossil fuels *(FAHS-uhl FYOO-uhlz)* — Fuels like coal, oil and natural gas that were formed from the remains of living things buried millions of years ago.

fuel *(FYOO-uhl)* — Anything that produces energy as heat when it is burned.

gas *(GAS)* — A substance that is not a solid or a liquid. The atmosphere of the earth is made up of gases.

greenhouse *(GREEN-hows)* — A room or building made of glass that uses heat from sunlight to provide a warm environment for growing plants.

natural gas *(NACH-uh-ruhl GAS)* — Gas formed in the earth and often used for fuel.

oil *(OYL)* — A greasy liquid that comes from plants, animals or minerals. Oils usually can burn easily, and they often are used for fuel.

oxygen *(AHK-sih-juhn)* — An invisible, odorless gas that is needed by almost all living things. Oxygen combines with hydrogen to form water. Oxygen also is needed to make things burn.

ozone *(OH-zone)* — Gas made of oxygen. In the upper atmosphere, ozone is important because it blocks harmful rays from the sun. Near the ground, ozone is a pollutant that can hurt eyes and lungs and harm plants.

plastic *(PLAS-tihk)* — Material made from chemicals, that can be shaped or molded into many different forms. The building blocks for most of the plastics that we use come from fossil fuels.

smoke *(SMOHK)* — The cloud-like mass of fine carbon particles rising from burning coal, wood, etc.

solar *(SOH-luhr)* — Having to do with or coming from the sun; **solar power** — Energy that comes directly from the sun.

soot (SUT) — Fine, black powder often produced when something burns.

ultraviolet light *(UHL-truh-VI-uh-luht)* — Kind of light with waves that have slightly more energy and shorter wavelengths than light that you can see. Even though we can't see it, ultraviolet light can cause sunburn and other damage to skin.

water vapor *(WAH-tuhr vay-puhr)* — Tiny drops of water floating in the air as mist, fog or steam.

wavelength *(WAYV-length)* — The distance between the peaks of a wave.

windmill *(WIHND-mihl)* — A machine that gets its power when a set of blades is turned by the wind. Windmills can be used, for example, to grind things, to pump water or to produce electricity.

The authors of this story – Barbara Tharp, Judy Dresden, and Nancy Moreno – are faculty members of the Division of School-Based Programs at Baylor College of Medicine (BCM) in Houston, Texas. They have been working together for several years on science education projects involving teachers and students from kindergarten through college. All are parents of teenage or grown children. As a team, they also created instructional materials for the *BrainLink*® project, which served as a model for My Health My World®.

- Barbara Tharp, M.S., originally from California and Oklahoma, once worked for the FBI in Washington, D.C., and later was an economic analyst for an oil company. More recently, she has followed her real interest in working with children as an elementary school teacher, specializing in her favorite subjects, science and math. Currently she serves as a full-time faculty member at BCM. In addition to creating instructional materials, she directs teacher enhancement programs as a master teacher working with other classroom teachers on new ways to teach science and math.

- Judith Dresden, M.S., originally from New York and New England, formerly conducted educational research and evaluation for public and private schools, specializing in language arts. Editorial work with a publishing company also led to her current interest in writing and editing stories and science activities for young students. As a BCM faculty member, she serves as director of the BrainLink project, which brings the complex concepts of neuroscience within the grasp of children. Other activities have been directed toward promoting access to health science careers.

- Nancy Moreno, Ph.D., from Wisconsin and Michigan, is a biologist who specializes in botany. She studied and classified neotropical plants in Mexico before completing her doctoral degree. Her current interests focus on the involvement of scientists in the education of students and teachers. She designs curriculum, conducts workshops for teachers on creative methods for teaching science and using technology, and is involved in science education at all levels. BCM's My Health My World project, which she directs, builds upon her special interests in ecology and environmental issues.

The illustrator, T Lewis, was born in Texas but has traveled extensively, living in such exotic locales as Africa, Switzerland and Alaska. Currently living in a small town in the state of Washington, where he and his wife are raising their young son, he "commutes" from time to time to Houston to work, in person, with BCM and other colleagues. He holds a bachelor of fine arts degree and has been a teacher in Alaska, 200 miles above the Arctic Circle. While there, he also created paintings that are included in a Smithsonian Institute collection of Alaskan art.

While his broad range of professional artwork has appeared in many formats, T Lewis is especially fond of creating illustrations for children. In addition to those for the BrainLink and My Health My World projects, recent books bearing his work are *The Forgotten Helper, Bedtime Rhymes from Around the World* and *Cinderella: The Untold Story.* He has drawn the "Mickey Mouse" comic strip for Disney Productions and co-authors the comic, "Over the Hedge," appearing in newspapers daily through United Feature Syndicate.

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Publications

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My Health My World® Adventures
Developed by
Baylor College of Medicine
Houston, Texas
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THE READING LINK

Reading activities to use with

MR. SLAPTAIL'S CURIOUS CONTRAPTION

RIFF AND ROSIE

MY HEALTH MY WORLD

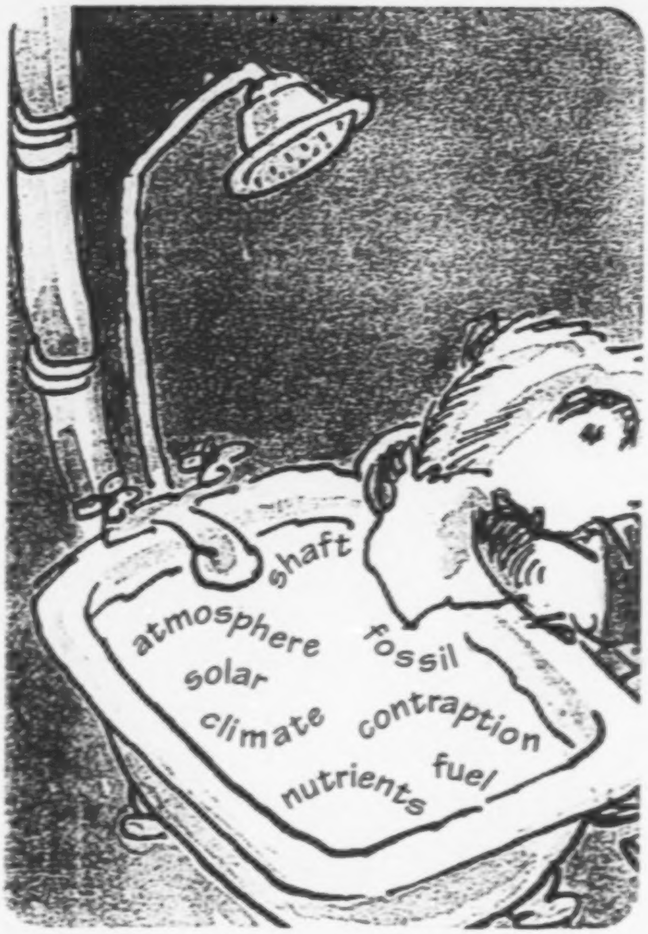
MY HOME PLANET EARTH

The Reading Links have been created as ready-to-use reading and writing activities that are directly related to My Health My World adventure stories. They are not intended to represent a comprehensive reading program. The activities are related to reading objectives common to many curricula and covering a range of grade and ability levels. Teachers may wish to select from these activities those that are most appropriate for their own students.

Prepared by
Baylor College of Medicine
Houston, Texas
1997

Word Meaning/Context Clues

A. **Tub of Words.** Find the word in the tub that fits best in each blank space. Write the correct words in the blanks.



1. That ______________ is the craziest looking machine I ever saw!

2. What happens to a house heated by ____________ power if the sun doesn't shine for a week?

3. This tunnel into the mine is blocked, so you'll have to use the other______________.

4. This ______________ shows the whole skeleton of a fish that died and was buried under the sea a million years ago.

5. If you eat nothing but candy and other things without many ________________, you won't stay healthy.

6. Gasoline is the ________________ most often used to make cars go.

7. Burning fuels that release carbon dioxide changes the ______________ of the Earth.

8. It's warm most of the time in Florida, but Michigan has a cold ______________.

Now choose any four of the words you have just used, and write a definition for each one. Here are the words:

atmosphere
solar
climate
nutrients
shaft
fossil
contraption
fuel

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

B. Many Meanings. A word can have more than one meaning. Look at the different meanings for mine and racket. Then pick the meaning of those words that fits best in each sentence. Write its number next to the sentence.

mine
1. an underground hole or tunnel from which minerals (like coal, iron or silver) can be taken
2. an explosive device that can be placed in the ground or water
3. something that belongs to me

_____ The soldiers were careful not to step on a land mine.

_____ This book is mine.

_____ They had little wagons to carry coal out of the mine.

racket
1. a device that has a frame with tightly laced strings and a handle, used to hit the ball in a game of tennis
2. a loud, unpleasant, clattering sort of noise
3. a dishonest scheme for getting money

_____ What is all that racket up on the roof?

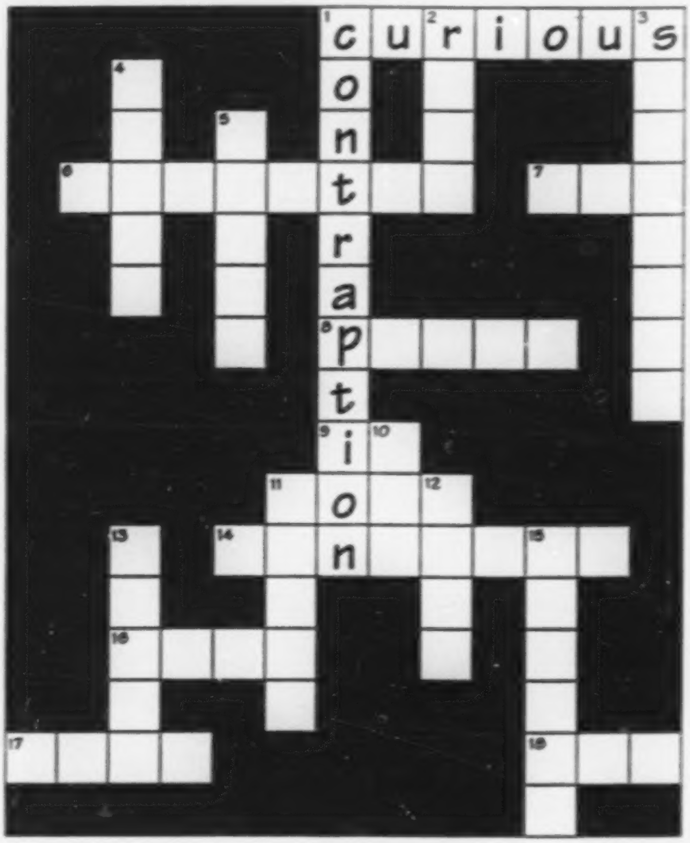
_____ The man looked honest, but his business was really a racket to cheat old people out of their money.

_____ Don't forget to bring your tennis racket to the park.

C. **Mr. Slaptail's Curious Crossword Puzzle.** All of the words in this crossword puzzle are in the story, *Mr. Slaptail's Curious Contraption.*

Across
1. Interesting because it is so unusual; wondering
6. The kinds of weather places usually have
7. A greasy liquid that often is used for fuel
8. Force; energy that can be used for doing work
9. Not out, but ________
11. Black powder made when something burns
14. A toy with a part that spins in the wind; Rosie made one
16. A black, solid substance formed in the Earth long ago
17. To change or destroy with fire or heat
18. A substance that is not solid or liquid

Down
1. A strange-looking gadget
2. Animals similar to mice; a word Riff uses when he's mad
3. Light from the sun
4. Coming from or related to the sun
5. A cloud rising from something that's burning
10. At the present time
11. Not very sensible; ridiculous; foolish
12. Not us, but _____
13. Mr. Otterbee's first name
15. Power that can be used to do physical work or provide heat



Sequence of Events

A. Read the chapter, "Off to the Coal Mine," on pages 12–15. Which one of the three things below happened FIRST in that chapter? Write 1 next to it. Then write 2 by the event that happened next, and 3 by the one that happened last.

_____ They called Beulah Diggerpaw's name, but there was no answer.

_____ Everyone got into Oscar Otterbee's old truck.

_____ They learned that there had been an explosion, and part of the mine had caved in.

B. After you have read the whole story, find the event below that happened LAST. Write 4 next to it. Then write the numbers 1, 2 and 3 to show the order in which the other events happened.

_____ Rosie made a pinwheel that worked like a real windmill.

_____ Ms. Diggerpaw decided never to go into the mine again.

_____ Mr. Slaptail built a contraption to heat water on his roof.

_____ A dark cloud of smoke rose in the air.

BEULAH DIGGERPAW'S
COAL COMPANY

Cause and Effect Relationships

Write your answer to answer each question:

Why did the neighbors stop in front of Mr. Slaptail's house?

____

____

____

____

What could Mr. Slaptail do because he had "greenhouse" windows?

____

____

____

____

Why did Beulah Diggerpaw decide to shut down her coal mine? (Give at least two reasons.)

____

____

____

____

What happened in Bright Water Corners because the coal mine was going to close?

____

____

____

____

Details and Supporting Ideas

A. At the beginning of the story, Riff and Rosie went to Mr. Slaptail's house. In your own words, write down what they saw there. Tell who, where and what. Include as many details as you can.

B. What time of year was it when this story took place? Circle your answer and list the reasons you think so.

I think this story took place in (circle one) **spring** **summer** **fall** **winter** because

1.

2.

3.

4.

C. Think about the characters in the story *Mr. Slaptail's Curious Contraption*. Choose which one is your favorite. Tell why you like that character the best, giving as many reasons as you can.

My favorite character in the story is___________________________.

That is because

____

____

____

____

____

____

____

____

____

____

____

Main Idea

A. **Choosing the Main Idea.** Look at the yellow box at the top of page 12. Which sentence below best tells the main idea of this Grasshopper's Science Box? Fill in the circle by your answer.

- ○ Did you know that burning is a chemical reaction?
- ○ When something like fossil fuels or wood burns, it uses oxygen.
- ○ Carbon dioxide and water vapor usually are produced at the same time.
- ○ When a fuel doesn't burn completely, it can make black smoke or soot.

Look at the yellow box on page 27. Which sentence below best tells the main idea? Fill in the circle by your answer.

- ○ We don't always need to use fossil fuels.
- ○ We can save fuels by riding a bicycle, walking, taking a bus or sharing rides.
- ○ We can use the power of water to make electricity.
- ○ Did you know that plastics come from fossil fuels?

B. Write one sentence that tells the main idea of the story, *Mr. Slaptail's Curious Contraption.*

Summarizing

A. Pretend that you are Rosie. Write a letter to a friend telling about Mr. Slaptail's contraption. What did it look like? How did it work? Why did he build it?

B. The citizens of Bright Water Corners thought of many ways to supply the town with energy, without burning coal. Name as many ways as you can.

Fact and Opinion

Facts are true. Opinions are what someone thinks, but they might not be true. Based on the story, tell whether you think each of these sentences states a fact or an opinion. Write **F** or **O** in each space. (Look back in the story if you need to.)

_____ Mr. Slaptail has lost his mind for sure. (pg. 3)

_____ Mr. Slaptail was building a submarine on top of his house. (pg. 4)

_____ With his solar water heater, Mr. Slaptail won't have to have a fire to get hot water anymore. (pg. 8)

_____ Mr. Slaptail can grow lemons in his house during the cold winter. (pg. 9)

_____ Ms. Diggerpaw can't shut down the mine, because everyone has to have coal for heat and for cooking. (pg. 22)

_____ Everybody could use power from the sun. (pg. 23)

_____ The solar water heater is a crazy idea that won't really work. (pg. 24)

_____ Mr. Blackduck's Grandpa used the wind for energy. (pg. 27)

_____ Bright Water Corners is going to be super-energy city. (pg. 27)

Following Written Directions

Follow the directions on page 32 to make a pinwheel. Work with a partner to make a pinwheel together the first time, and then make and decorate your own pinwheel.

Inferences/Generalizations and Conclusions

A. Fill in the circle by the word that best answers each question:

1. At the beginning of the story, the neighbors thought Mr. Slaptail was ________________ for building a contraption on his roof.

○ smart
○ friendly
○ crazy
○ angry

2. How do you think Riff and Rosie felt when they heard a loud BOOM and saw smoke in the distance?

○ excited
○ worried
○ happy
○ angry

3. How did Mr. Slaptail feel when he said, "There's an old entrance on the other side of the mine . . . . Maybe we could get in that way."?

○ frightened
○ angry
○ sad
○ hopeful

4. How did Ms. Diggerpaw feel about having to close down her coal mine?

○ frightened
○ excited
○ sad
○ happy

B. After you have read *Mister Slaptail's Curious Contraption,* decide whether you think each of these sentences is True or False. Mark T or F on the line by each sentence. If you decide a sentence is false (it does not state a logical conclusion from the story), rewrite it below to make it a true statement.

_____ Mr. Slaptail is a clever inventor.

_____ Without the sun, there would be no life on Earth.

_____ When coal is used up, it is easy to make more.

_____ Carbon dioxide is needed to hold heat near the surface of our planet.

_____ Nothing we do changes the atmosphere around the earth.

_____ Beulah Diggerpaw is too old to work anymore.

Rewrite False sentences to make them true:

Predicting Probable Outcomes

A. What do you think will happen after this story ends? Choose which one of each pair you think is most likely to happen. Mark it with an X.

_____ The people of Bright Water Corners will find it is too hard to do without coal. They will go to Carbon Mountain to get coal.

OR

_____ The people will keep using new energy sources like windmills and sun, and they will notice that their air is cleaner.

_____ Riff will decide that he doesn't like visiting Bright Water Corners in the summer, and he will not come back next year.

OR

_____ Riff and Rosie will continue working and learning with Mr. Slaptail in the summers.

_____ Mr. Slaptail will discover many more things that can run on solar power, and he will make other energy-saving inventions.

OR

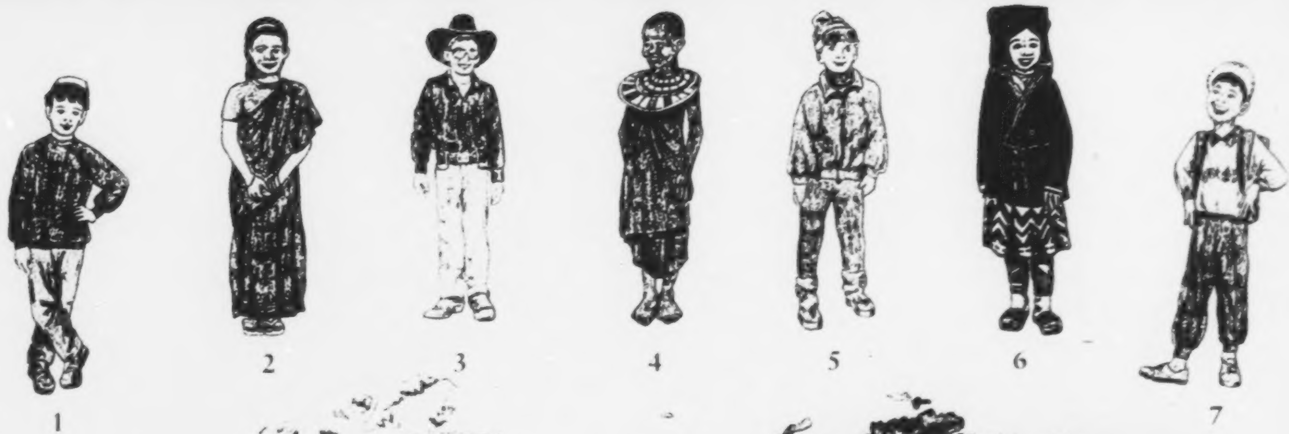
_____ Mr. Slaptail will decide that all of these inventions are boring, and he will go back to his old ways.

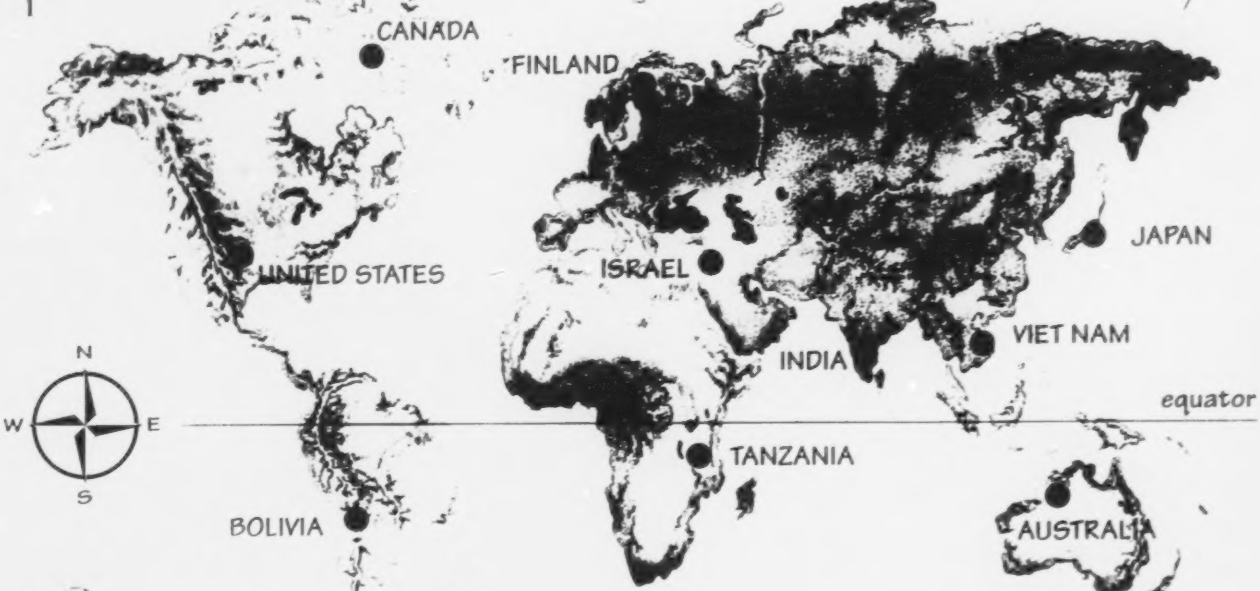
B. What else do you think might happen in Bright Water Corners after they have changed the ways they get energy? Write a paragraph, telling what you predict.

MY HEALTH MY WORLD
MY HOME PLANET EARTH

EXPLORATIONS

FOR CHILDREN AND ADULTS




CANADA
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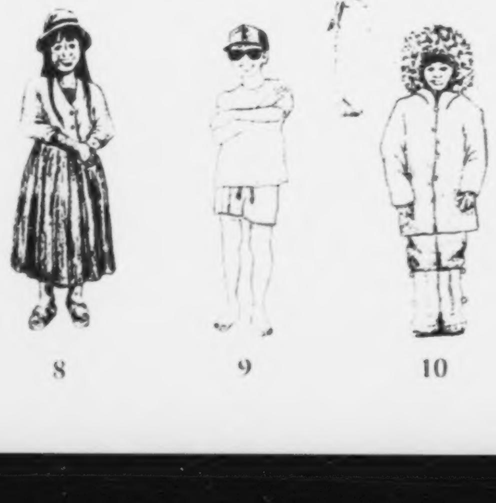


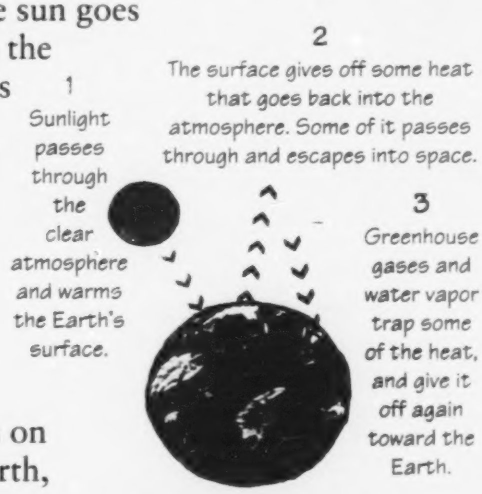
The clothing that children wear depends on where they live. Some kinds of clothes are for sun protection. Other kinds are for warmth. Can you tell where these children live? The names of the countries where the children live are given next to a dot showing the location of their home. Draw a line from each child to where you think he or she lives. (Turn to page 8 to see if you are right.)

Let's Talk *about...* The

Have you ever wondered about the sky above you? When you look upward, you are seeing part of the Earth's atmosphere. The atmosphere is the layer of air around the Earth. Air contains nitrogen, oxygen, and other gases like carbon dioxide, water vapor and ozone.

Almost all the gas around our planet is in a thin layer that is about 60 miles high. This is the same distance that you might travel on a highway if you drove for an hour.

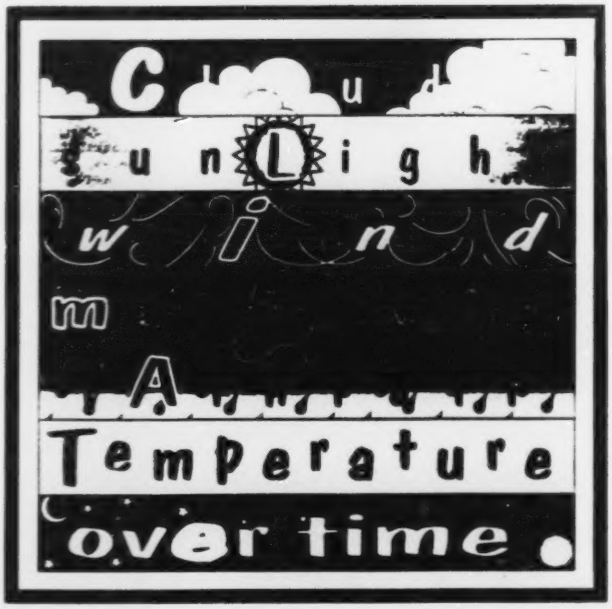
Energy from the sun. Have you ever noticed how warm a car can get inside when it's parked in the sun? Light energy from the sun goes through the windows and is trapped as heat inside the car. The same thing happens on Earth, except that some gases, like carbon dioxide, act like the car windows and hold heat inside. It's a good thing that they do, because otherwise Earth would be a lot colder! The only problem is that we are putting extra heat-trapping gases into the atmosphere. This might make the Earth get warmer.


2
The surface gives off some heat that goes back into the atmosphere. Some of it passes through and escapes into space.
1
Sunlight passes through the clear atmosphere and warms the Earth's surface.
3
Greenhouse gases and water vapor trap some of the heat, and give it off again toward the Earth.

The Greenhouse Effect

If the Earth gets even a little bit hotter, the climate in many different parts of the world could change. Some places would get warmer and drier. Other places might get more rain. This would

What is Climate?


C u
u n L i g h
w i n d
m
A
Temperature
over time.

Atmosphere & Health

affect farms, forests, wildlife — just about everything on the planet.

Whoops!
Some chemicals we use go up into the atmosphere and destroy part of the layer of ozone that protects us from UV radiation. Most of these are CFCs. CFC stands for chlorofluorocarbon (KLOR-oh-FLOR-oh-KAHR-buhn). These chemicals can be used in air conditioners, refrigerators and some aerosol cans. Almost all countries on Earth have agreed to stop putting CFCs into the atmosphere.

The atmosphere is special.
The atmosphere protects us from dangerous rays produced by the sun. We can see part of the energy from the sun as light, and feel part of it as heat. But the sun also sends out other kinds of energy. Some of these, like ultra-violet — or UV rays, can be harmful to living things. UV radiation makes your skin turn red if you are in the sun too long. UV rays also cause skin cancer in people if they are in the sun too much. A gas in the atmosphere, called ozone, soaks up almost all of the UV rays from the sun, but some still get through.

Tips for Healthy Living

Protect the atmosphere. Protect yourself.

- Use less fossil fuels — ride the bus, ride a bicycle or walk whenever it's safe and possible.
- Plant trees and other plants, which will take up carbon dioxide from the air.
- Try to save energy. Turn off lights and appliances when not in use.
- Save on heating and air conditioning by wearing sweaters when it's cold and short-sleeved shirts when it's hot.
- Add insulation to your house to keep warm air from escaping in winter and cool air from escaping in summer.
- Look for products in spray cans and coolants that don't contain CFCs.
- When in the sun, wear a hat and a shirt with long sleeves.
- Always wear sunscreen and sunglasses that protect against UV radiation!

Fossil fuels, like coal and gasoline, come from plants that died millions of years ago. These plants took in carbon dioxide from the air during photosynthesis. When we burn fossil fuels today, carbon dioxide goes back into the atmosphere.

DID YOU KNOW that the greatest risk from sun exposure is between 10:00 in the morning and 4:00 in the afternoon? Find these times after you make the sundial below.

Try This!

You can make a model of the way our Earth's environment is affected by natural and man-made disasters. You will need a paper plate (wax coated works best), one fourth cup whole milk, food coloring (red, blue, green and yellow), and dishwashing soap, preferably clear or light colored.

1. Mark the four directions (North, South, East and West) on the outer edge of your paper plate. Consider where the major continents would be in relation to the directions. (You can use the cover of this Explorations as a guide.)

2. Pour the milk into the plate. This represents the atmosphere surrounding the Earth.

3. Place several drops of each color of food coloring randomly in the milk. Each drop will represent a different global disaster. For example, the red drops could represent a forest fire, green — volcanoes, and yellow — pollution due to car exhaust.

4. Look at the colors on your plate. Are they spreading and running into each other? Is each "disaster" isolated in its own area?

5. Now, put several squirts of dishwashing liquid randomly into the plate. This represents energy from the sun.

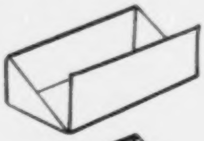
6. Observe. What happens to the disasters represented by the colors?

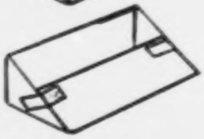
Weather and ocean currents all are caused by heating and cooling of different parts of the Earth's surface.

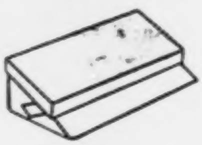
Sun Power

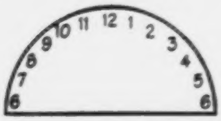
Use the sun to tell time by making a sundial! You will need a shoebox, a paper plate, tape, scissors, and a popsicle stick or pencil.

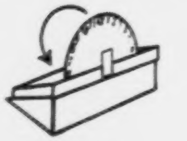
1. Cut the sides of a shoebox as shown.
2. Fold the long edge of the box down and tape into place.
3. Place the shoe box lid over the box.
4. Cut the paper plate in half. (You will only use one of the halves.)
5. Make a mark at the center of the curved edge of the half plate. Label it "12."
6. Make 5 evenly spaced marks on each side of the "12" and label as shown.
7. Tape the plate on the top of the lid, with the straight edge at the top of the box. Fold the plate over and tape down.
8. Tape the popsicle stick so that it points straight up as shown.
9. Put your sundial in the sun, facing North. Where does the shadow fall? Compare the time on your sundial to the time on a clock.

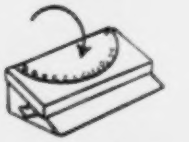


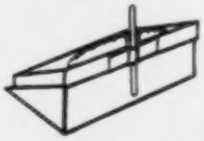












we can make a difference!

We are students at Islands Elementary School in Savannah, Georgia. We are learning about the Earth's climate. We are part of the GLOBE program.

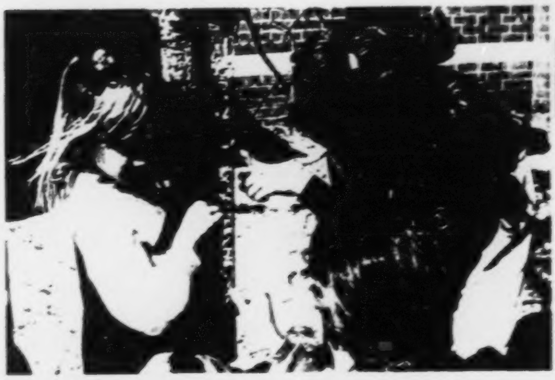
Every day we measure air temperature and rainfall near our school.

We use computers and the Internet to share our measurements with other students and scientists.

We are checking the temperature.

All of us together are looking for answers about the Earth's climate. We would like to know how our climate could be changing. What do you think?

This is our weather station.



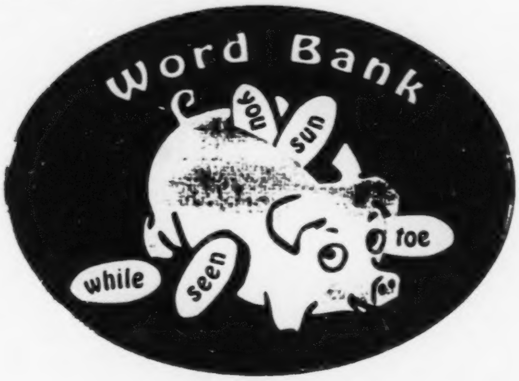
We are measuring rainfall.

U.S. Vice President Al Gore came up with the idea of a world-wide program on the Earth's environment. He thought that students and teachers in every country could get involved.

Students and teachers from over 3,000 schools in 44 countries are working with scientists to learn more about our planet. Find out how you can be a part of the worldwide GLOBE program. You and your teacher can call the GLOBE program at 800/ 858-9947. You also can visit the GLOBE World Wide Web site at: http://www.globe.gov

115

Here is a poem about an important part of your body. Some words have been left out. Read the poem, and fill in the missing words as you go. Choose the right word for each space from the Word Bank. The last word is *not* in the Word Bank. Guess what it is, and you will know the answer!



It holds me tight,
won't let me go.
It covers me
from head to ______________

It keeps my insides
safe and clean,
and keeps out germs
not even ______________

It wrinkles up
each time I smile,
or cry or frown,
once in a ______________

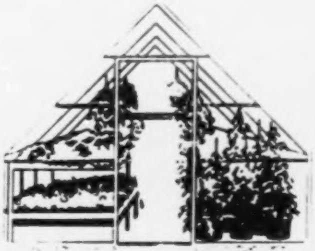
It goes with me
outdoors for fun.
But it can hurt
from too much ______________

It comes in shapes
and colors, too.
Your own is special,
just for ______________

Mine's on my face,
my arm and shin,
my front and back —
It is my ______________

Not such a new issue...

Swedish scientist Svante Arrhenius was the first to use the phrase "greenhouse effect." He used it to describe how carbon dioxide and some other gases keep the Earth warmer than it would be otherwise. Can you guess why he called it that?



Have you ever seen a greenhouse — a glass building or room where it is warm enough to grow summertime plants in cold weather?

Rosie and Riff talk to...

Lief Sigren

RICE
HEALTHY EATING

Dr. Sigren, what do you do?

I am a wetland ecologist. I study the release of methane gas from rice paddies, which are a type of wetland, since they are flooded during the growing season. We are interested in methane because it is a greenhouse gas, like carbon dioxide. This kind of gas traps heat in the atmosphere and adds to global warming. We would like to find ways to grow rice so that the fields give off little methane and produce as much food as possible. This is very important because the population of the Earth is growing.

How did you decide to do this kind of work?

I was a high school teacher for 10 years before I decided to go back to school and get my Ph.D. (a doctor's degree in science). I always have been interested in the environment, and I chose this kind of research because it affects the whole world.

Some of us are not wearing hats, but we always wear sun screen when we are in the field.

Have you always been interested in science?

Yes. I always enjoyed science. At first I thought I would study physics, but I decided that I liked biology better, especially ecology.

What do you like most about your work?

I like knowing that my work is important to the well-being of everyone, all over the world. I also find it fun! We work hard in the rice paddies and in the lab, but we have fun at the same time. There are many birds, frogs, snakes and even alligators in our rice paddies.

Is there anything else you would like to tell our readers?

Science can be fun! For your life's work, choose something that you really like doing. Then you will enjoy working as hard as you can.

SKIN WISE

MAKE A THUMBPRINT THAT YOU CAN KEEP!

1. Rub a pencil on a piece of paper until you make a solid, dark spot about 2–3 cm in diameter.

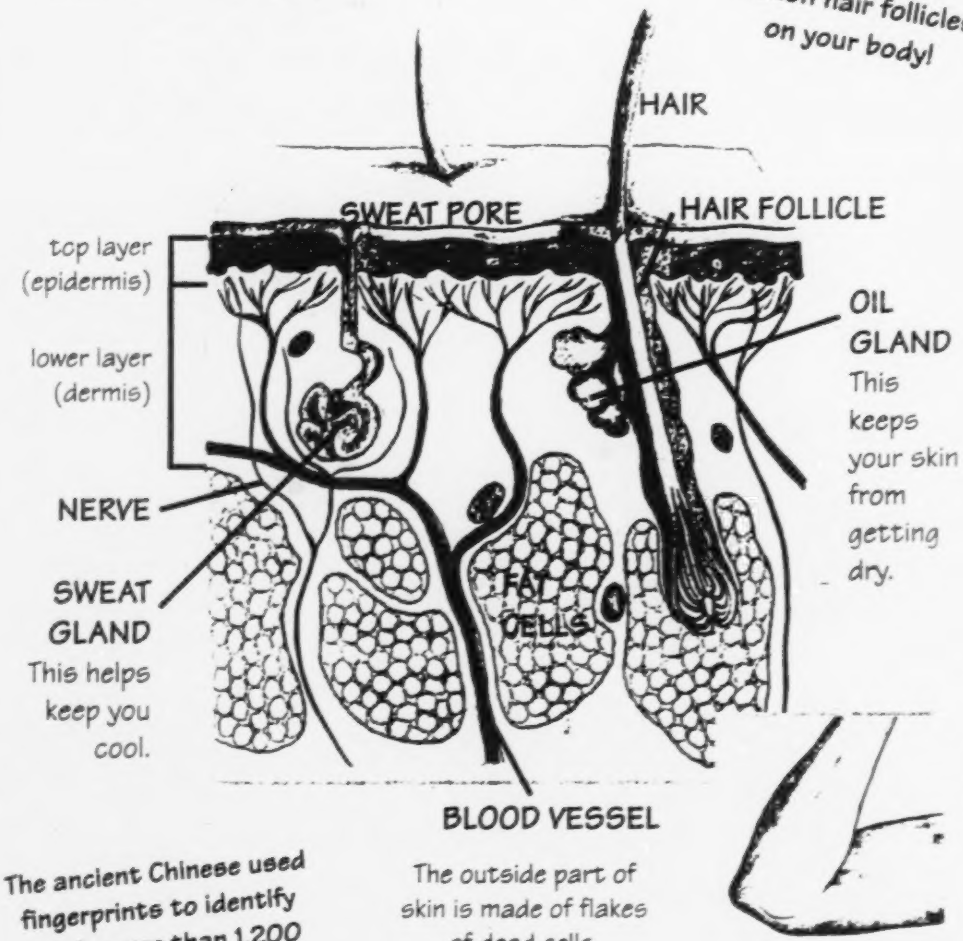
2. Rub your fingertip or thumb over the spot.

3. Now, stick a piece of clear tape over the smudge on your fingertip.

4. Stick the tape onto a piece of paper.

This is a drawing of skin from the human scalp.

You have around 5 million hair follicles on your body!



OIL GLAND This keeps your skin from getting dry.

SWEAT GLAND This helps keep you cool.

The ancient Chinese used fingerprints to identify people more than 1,200 years ago.

The outside part of skin is made of flakes of dead cells.

Look at your elbow. Can you figure out why it looks wrinkled sometimes?

Answers to Map Puzzle

1. ISRAEL
2. INDIA
3. UNITED STATES
4. TANZANIA
5. FINLAND
6. VIET NAM
7. JAPAN
8. BOLIVIA
9. AUSTRALIA
10. CANADA

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